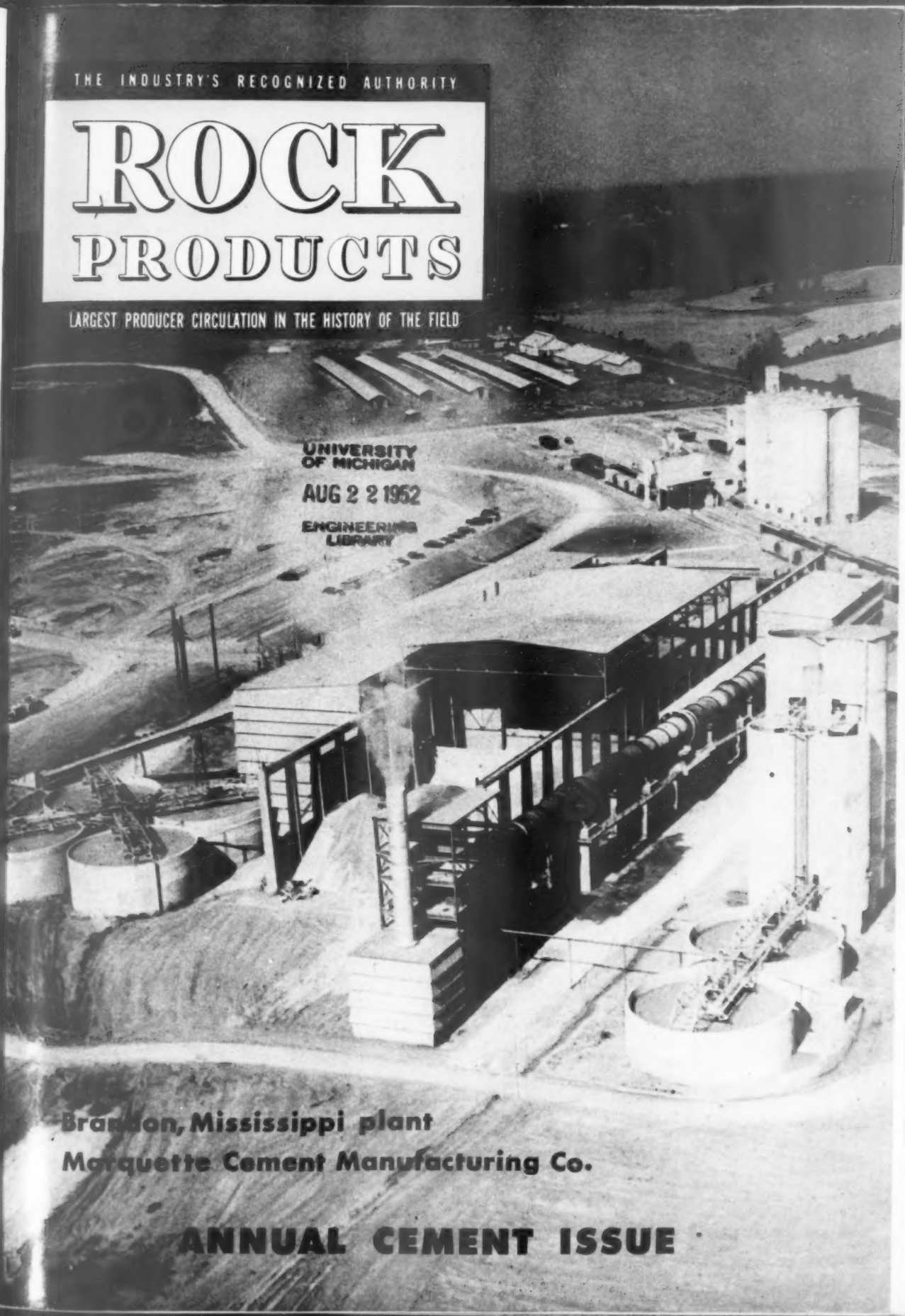
THE INDUSTRY'S RECOGNIZED AUTHORITY

ROCK PRODUCTS

LARGEST PRODUCER CIRCULATION IN THE HISTORY OF THE FIELD

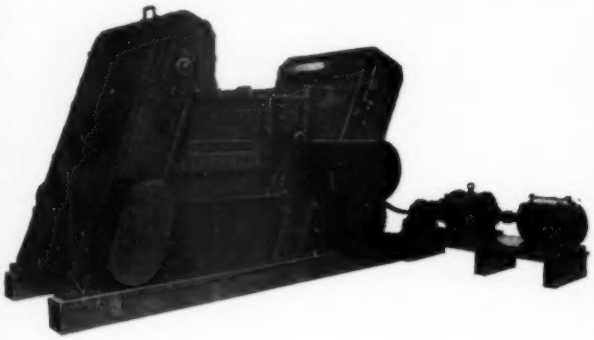


Brandon, Mississippi plant
Marquette Cement Manufacturing Co.

ANNUAL CEMENT ISSUE

CEMENT MILL OWNERS KNOW THE VALUE OF GRUENDLER EQUIPMENT

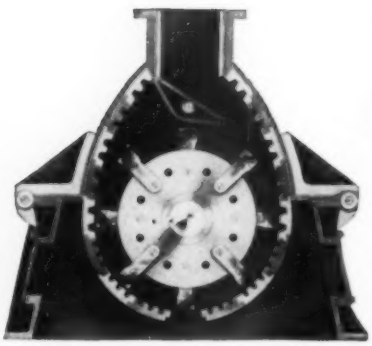
LONG LIFE, MINIMUM DOWNTIME AND CONSERVATIVELY RATED



The Gruendler Traveling Breaker Plate Crusher for handling moist and sticky material. Manufactured in sizes as small as 5 tons hourly to as large a unit producing upwards to 400 tons hourly.

Sturdily built cast steel or welded frame construction having greater rigidity and long life with minimum interruption.

Gruendler Conventional Hammermill, all dry material and generally used for secondary operation. Many still in operation after 18 years of service.



Gruendler Centerfeed combination impactor and pulverizer. Where a greater degree of fineness is desired, and where increased production of your ball or tube mills is a necessity, you will find Gruendler's dependable performance superior to all others.

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ST. LOUIS, U.S.A.

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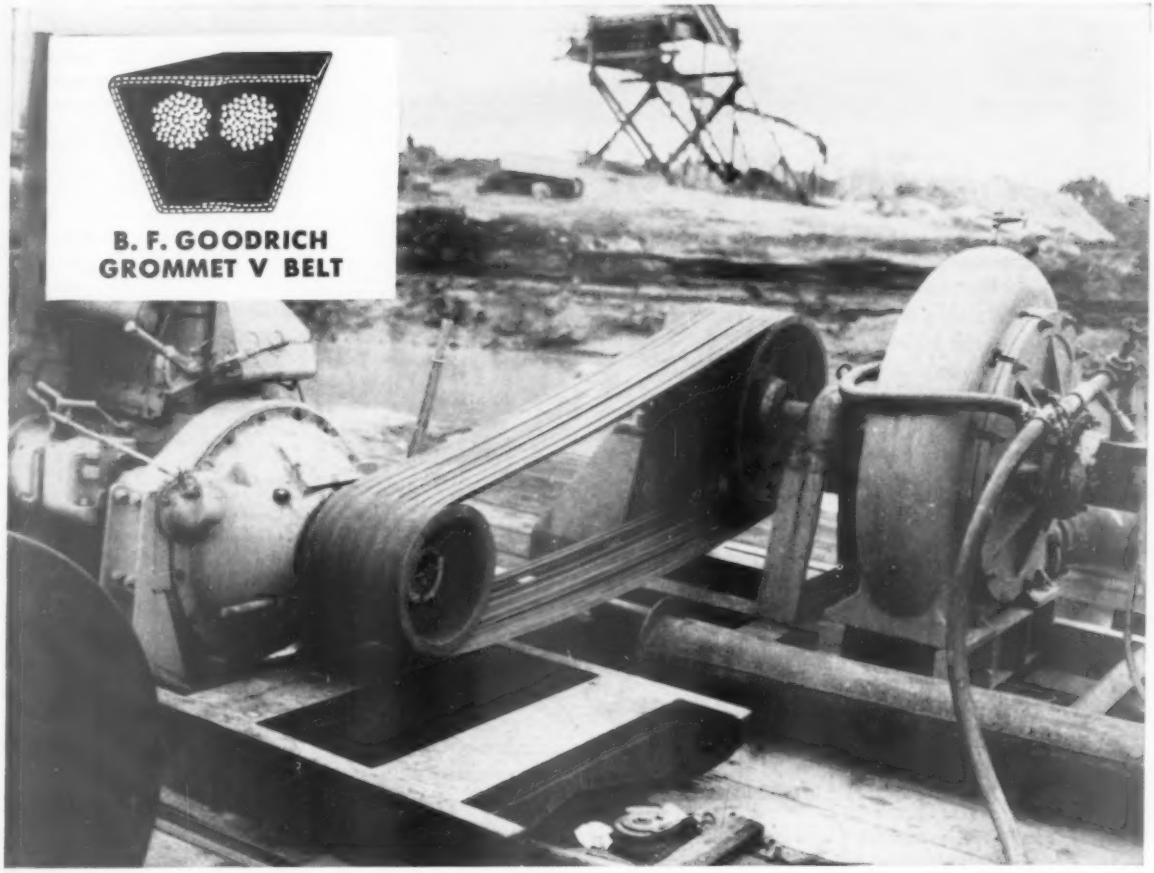
RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER



Where B. F. Goodrich grommet belts are outlasting others 2 to 1

B. F. Goodrich grommet V belts cut costs 20 to 50%

THOSE nine belts run a sand pump 10 hours a day, 6 days a week. Ordinary V belts had to be stretched extra tight in order to run the heavy pump. In addition to causing bearing wear, the tight fit pressed sand into belts and pulley, resulting in serious wear on both. When B. F. Goodrich grommet V belts were installed, it was found they gave good gripping action, even though not tightened. With belts running at less tension, abrasive wear was cut way down, belt and pulley life doubled, and heavy bearing wear in the motor eliminated. Here's the reason B. F. Goodrich grommet V belts outperform ordinary belts:

No cord ends — A grommet is endless, made by winding heavy cord on itself to form an endless loop. It has no overlapping ends. Because most of the failures in ordinary V belts occur in the region where cords overlap, the endless cord section in a grommet V belt eliminates such failures.

Concentrated cord strength — All of the cord material in a B. F. Goodrich grommet multiple-V belt is *concentrated* in twin grommets, positioned close to the driving faces of the pulley. No layers of cords to rub against one another and generate heat; cord and adhesion failures are reduced.

Better grip, less slip — Because a grommet is endless, a grommet V belt is more flexible, grips the pulleys better. Size for size, grommet multiple-V belts will give ⅓ more gripping power, pull heavier loads with a higher safety factor.

Only B. F. Goodrich has the grommet!—No other multiple-V belt is a grommet V belt (U. S. Patent No. 2,233,294). Now available in C, D and E sections. See your local B. F. Goodrich distributor. *The B. F. Goodrich Company, Industrial & General Products Division, Akron, Ohio* (available in Canada).

Grommet V Belts BY

B.F.Goodrich

RUBBER FOR INDUSTRY

ROCK PRODUCTS

AUGUST, 1952 — THE INDUSTRY'S RECOGNIZED AUTHORITY — VOL. 55, No. 8

This Month

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"WE HEAR..."

August, 1952

The first of the defense materials promised to the U.S. government by the striking C.I.O. steelworkers began flowing the last of June. The materials, however, were not steel, but lumnite cement, used to make jet engine testing cells. Approximately 521 bbl. of this cement were shipped from the Buffington, Ind., plant of Universal Atlas Cement Co. Aside from this, the defense materials remained locked inside strike-bound warehouses and mills despite a government-industry plan to get the needed materials, particularly finished steel, moving to aid the armed forces.

* * * * * * * * * *

Two 50-lb. cases of dynamite were recently stolen from a Springfield, N.J., quarry. This was the second time in one week that thieves had broken into the quarry shed where the dynamite was stored. New locks on the door after the first theft failed to deter the determined thieves. Part of the dynamite was recovered after an anonymous phone call from a young boy tipped the police as to where part of the dynamite was hidden.

* * * * * * * * * *

An acrylonitrile soil conditioner, in liquid form, is now being produced in Canada under the trade name of "Poly-Ack." One gallon is said to cover 1000 sq. ft. Another acrylonitrile-based product, "Loxar," is being produced in dry salt form. In the U.S., several chemical firms are marketing these new products and others are preparing their own products for market. A plant is being constructed at Texas City, Texas, to produce an acrylonitrile soil conditioner. This type of soil conditioner is said to be particularly effective in breaking down hard clays.

* * * * * * * * * *

Waste wood, formerly a worthless product of paper mills, may soon become one of the southern pulpwood industry's leading money makers, according to a recent announcement in Business Week. A Georgia company has developed a low-pressure, low-temperature "cooking" technique that uses waste wood to produce paper with high resistance to tearing and bursting.

* * * * * * * * * *

Two new toll super highways have been proposed for the state of Tennessee, according to Engineering News-Record. One, 400 miles long, from Memphis to Bristol, would link with the proposed Virginia Turnpike. The other, from Knoxville to Chattanooga, would link with the Georgia Turnpike.

* * * * * * * * * *

Certificates of necessity, with tax write-off benefits, have been issued for more than 350 electric power expansion projects, involving expansions valued at about $2.5 billion. Nearly 200 applications covering expansions valued at about $1 billion have yet to be acted upon.

* * * * * * * * * *

Heavy construction awards, nationally, totaled $7,005,919,000 for the first 27 weeks of 1952, compared with $7,687,584,000 for the corresponding period of 1951, as reported by Engineering News-Record. Highway construction awards totaled $784,100,000 for the 1952 period, which was 35 percent above the 1951 figure. Private mass housing awards of $1,510,500,000 were 41 percent above the same period for 1951.

* * * * * * * * * *

A $60,000 contract has been awarded to the University of Nevada by the U.S. Atomic Energy Commission for developmental studies of methods of processing uranium ores and concentrates. The university will study benefication of low-grade uranium ores and extractive metallurgy for the recovery of uranium and other valuable by-products from ores and concentrates.

WE HEAR

The Ohio Supreme Court recently upheld the validity of the Ohio Turnpike Act, thereby removing the last legal obstacle for the highway's construction. The court decision also practically insures delivery by September 4 to a syndicate of 411 investment houses the $326,000,000 bonds sold to finance the 241-mile road across northern Ohio.

* * * * * * * * * *

Home building in Western Europe faces its first downward turn since World War II, as recently reported in The Wall Street Journal. In West Germany, 435,000 new dwelling units were completed in 1951, which was more than one-third above the 1950 figure. But by autumn, authorizations for new home building had dropped to 20 percent below the level of 1950. Denmark's house completions in 1951 were maintained at 1950 levels, but new starts were down 30 percent. In Switzerland, Belgium and Holland, experts are predicting less house-building activity this year. The shift is a reversal of a trend that had pushed home construction well above prewar levels in nearly every Western European country except France and Great Britain. In France, low-level rent ceilings discouraged investment in home building; in Britain, materials and labor have been scarce.

* * * * * * * * * *

The only known source of silica in southeastern Asia was recently discovered on Pulau Tekong Island, a few miles off shore from Singapore. Analysts report that the sand on the island's beaches contain 99.5 percent of silica, from which lenses, cut glass and other high-quality glass can be made.

* * * * * * * * * *

The railroads turned back an estimated 5,561,000 tons of scrap iron and steel to the steel industry in 1951. The total represented about 14.7 percent of all scrap purchased by the steel mills and was the largest amount ever turned in by the railroads in any one year, as was reported by the Association of American Railroads. During the period of 1944-1951, the railroads provided an average of 4,173,000 tons of iron and steel scrap annually, or 14.4 percent of all scrap purchased by the steel industry. During the same period, the railroads received approximately 8.7 percent of the total finished steel production.

* * * * * * * * * *

More than 350 miles of earth roads in Clackmas county, Ore., will be treated with waste sulfite liquor this summer, as recently reported in Engineering News-Record. The road binder will be furnished without cost by a newsprint manufacturing company. The binder is sprayed on unpaved roads to eliminate dust and prevent road deterioration. If experiments prove satisfactory, it is planned to tap other paper mills for additional supplies of the waste product.

* * * * * * * * * *

Total construction awards for the 37 states east of the Rockies totaled $6,269,728,000 for the first five months of 1952, according to an F. W. Dodge Corp. report. This was a decrease of 15 percent, compared with the same period in 1951. Construction awards for the month of May totaled $1,563,660,000, a 2 percent decrease from April and 39 percent below the May, 1951, figure. The May, 1951, total, however, was abnormally high, due to the inclusion of $980,000,000 awards in Atomic Energy Commission projects. Exclusive of the A.E.C. awards in May, 1951, the difference percentagewise with May, 1952, was only 2 percent.

* * * * * * * * * *

Deliveries of new freight cars in June, 1952, totaled 8411, compared with 6857 in May, and 9644 in June, 1951. Orders for new freight cars totaled 3264 in June, 1952, and the backlog of cars on order was 99,615 as of July 1, compared with a backlog of 147,725 orders on July 1, 1951.

* * * * * * * * * *

Production of industrial chemicals reached an all-time high in April, 1952, leading all other production categories in industrial growth, according to Chemical and Engineering News. The index production figure for industrial chemicals in May was 567, using the average from 1935 through 1939 as 100. This represents a gain of four points for the month of May and 35 points over the year before. All industrial production for April was indexed at 214. Transportation equipment, with an index of 327, ranks second in industrial growth. The index production figure for iron and steel was listed at 245.

THE EDITORS

Editor's page.....

The problem of high-cost cement plant expansion

The fact that portland cement prices have increased only 61 percent over the 1939-1951 period, whereas the average price for all building materials had increased 150 percent is a remarkable tribute to the productive ingenuity of the industry.

Cement manufacture is a complex process requiring expensive heavy machinery which is subject to rapid wear and which often becomes obsolete or inefficient long before the end of its useful life.

Competitive selling prices obviously are based upon depreciation charges applying to plant facilities built years ago at far less cost and they also reflect that large portions of existing plants are completely depreciated.

Because of the competitive conditions in the industry, with many completely depreciated facilities that determine price, it is surprising how much production capacity is being added and that major replacement continues on such a large scale. Major replacement costs are about three times original costs and it is generally agreed that new plants cost about $10 per barrel of annual capacity.

Need for Replacement

Executives of the industry find it difficult to justify large-scale replacements of old manufacturing facilities on the basis of economics alone, and much of such expenditures are being made simply because existing facilities were worn out to the point that something had to be done. The larger net income which heavy investment costs require, in view of excessive taxes also, is proving difficult to secure even when large operating savings result from the new installations.

In cases of large expansions to productive capacities, higher costs and increased taxes have offset the benefits from volume increase, to a great extent, but without the increased production and higher sales and gross profit, the companies involved would not have been able to continue paying decent dividends. Thus, some concerns have literally been forced to risk possible over-expansion for the future in order to increase volume sufficiently to offset rising costs.

It is expected that productive capacity will have been increased to 265,000,000 bbl. by the end of this year which means that the industry will have some 60,000,000 bbl. more of cement to sell than three years ago. The industry has assumed the risk of disposing of this added capacity because of the nation's population growth, an accumulating heavy backlog of needed civilian construction and the increasing share of the construction dollar that is being spent for cement.

A few new plants have been built near fast-growing markets in the Southeast and Southwest to offset high transportation costs, which is sound investment in the future by those concerns which could spread the inflated investment costs over an established business and thus rely on an over-all satisfactory return.

Cutting Expansion Costs

Most of the new capacity, however, has come from additions to existing plants which has been the best solution to justify the required investment at current high costs with the earning potential at current modest cement prices. This necessary concentration of added productive capacity at established plants does not fit the pattern of more geographic dispersion of the industry, which is fairly well dispersed anyhow with respect to raw materials and markets. However, it is serving the present purpose well in increasing cement supply and reducing unit costs.

Very sizable increases in capacity are being obtained from many existing plants at $3 or $4 invested per barrel of capacity, not including additions to all departments of course, but these plants may later have to reach out farther for markets at the sacrifice of net income per barrel. Those plants which were designed from the beginning to provide for future expansion within original structures have proved most economical to expand, and it is of interest that all the new mills are designed with that in mind for the future.

High costs of plant expansion are also being met by the building of distributing plants on navigable waters to take advantage of low-cost water transportation and thus confine necessary enlarged productive capacity to a single existing manufacturing plant. The shipping of clinker by water to be ground into cement in consuming markets is another approach.

Through intelligent planning and the use of approved accelerated amortization of building costs, the cement industry is being rapidly equipped to meet future demands for cement at low prices to the consumer.

Bror Nordberg

Rocky's NOTES

Nathan C. Rockwood

Rock products chemistry of the future

SPECIALIZATION IN SCIENCE has its drawbacks as well as advantages; this being particularly so to one trying to get a grasp of even one branch of science such as mineralogy. It is obvious, of course, that research in portland cement involves not only chemistry and physics but mineralogy, and special branches of mineralogy such as crystallography, petrology, etc. Since it probably takes a specialist in any one of these various branches of mineralogy practically his whole working time to keep abreast of developments in that particular field, it is not to be wondered that few find time to explore possible applications of science as a whole.

We are quite well aware that for such as the writer to dabble in fields where experts fear to tread, is opening the door to a charge of "the blind leading the blind." However, if our readers can get our point of view they will understand that we are merely trying to share various intellectual adventures with them. What we may write is not intended to be critical of researchers who are far better informed in these various branches of science than you and we are, but merely to try to convey an idea of the wealth of science that may yet be applied. Every new report on concrete and cement research should be suggestive of applications of fundamental facts in one or more of these sciences. Eventually the correlation of many divergent data will become apparent.

As a confessed amateur we always think of portland cement and lime as "minerals." We find, however, that to simon-pure mineralogists they are not minerals, for only naturally occurring combinations of the same elements are so classified. Yet cement and concrete are made from minerals by processes that closely parallel those of nature in forming similar combinations. Therefore, it seems to us, one who would progress in an understanding of cement and concrete research, having to start with some small amount of basic knowledge of chemistry and physics, should acquire also some comprehension of mineralogy. He need not absorb enough to go into a laboratory and identify a rock, or to lecture on the genesis of that particular kind of rock, but he should have enough understanding of the subject to see applications to problems with which he is constantly confronted.

Elementary Mineralogy

We have long been on the lookout for a more or less elementary but up-to-date textbook on mineralogy, and recently we received a review copy of "Dana's Manual of Mineralogy," *16th edition, revised by Cornelius S. Hurlbut, Jr., associate professor of mineralogy, Harvard University. Dana is perhaps the most famous name in the science of mineralogy, but this original textbook was written long before the present atomic theory of mineral structure was developed. Indeed great progress has been made in the science since the 15th edition of this text was published in 1941. Hence, while a great name is retained, it is evident that the text itself must have been entirely rewritten and rearranged. This textbook offers an excellent introduction to the science, and we recommend it unreservably.

After an introductory chapter (1) covering the history of mineralogy, the nature of minerals and applications of the science, the book is divided into seven sections as follows: (2) crystallography; (3) physical mineralogy; (4) chemical mineralogy; (5) descriptive mineralogy; (6) occurrences and association of minerals; (7) mineral uses; (8) determinative mineralogy. It is obvious that one can not obtain a working knowledge of any of these subjects without laboratory experience, but he can obtain enough grasp of any of them to understand at least the significance of the laboratory work that some of those who specialize in cement and concrete research do. For some who want to pursue the difficult subject of crystallography further, another new textbook, just received, is recommended. It is "Elements of Optical Mineralogy" † by Drs. Alexander N. Winchell and Horace Winchell.

Crystallography

Naturalists were early intrigued by the beauty and regularity of certain mineral crystals, and they developed the science chiefly as a means of classifying and identifying minerals. To do this, crystals had to be accurately described. So there are about 14 fundamental geometrical forms—cubes, pyramids, prisms, etc., but there is a bewildering array of combinations of these, which discourage the amateur from early pursuit of detailed knowledge of the subject. Scientific descriptions of crystals require reference to axes, parallel and perpendicular to the faces or surfaces, the angles between the faces and axes, etc. These data have been measured and tabulated for a great variety of mineral crystals, and a large part of any textbook on mineralogy and crystallography consists of descriptions based on these data, so that by reference to them the investigator may identify crystals. This is "descriptive" mineralogy. It finds application in study of the crystal composition of mineral aggregates and for identifying crystals in portland cement clinker, which, however, are not true minerals by the definition we have quoted above. Most of these cement clinker "minerals" are unstable in the presence of either air or water, which accounts for the fact that they are never natural combinations.

With the introduction of X-ray methods of chemical analysis, crystallography became more important because it was then possible to prove that the geometric shapes of crystals were the result of geometrical arrangements of the ions composing the crystals. Hence structural chemistry of inorganic or mineral substances was found to be no simple combination of atoms and molecules of the substance but complicated "co-ordinations" of ions, so joined that the electrical charges in such a co-ordinated "cell" as a whole were counterbalanced. This counterbalance can be destroyed in a variety of ways, application of heat, or dissolving the substances, being those most commonly employed. Thus application of high heat destroys the co-ordination of calcium and carbon trioxide (CO_3) ions in limestone (calcium carbonate) and results in the formation of lime (calcium oxide) and carbon dioxide (CO_2) gas. The CO_3 is called an acid radical ion and it is not easy to separate the C from the O entirely. CO_3 acts as a unit in all the mineral carbonates. Similarly when limestone is dissolved in an acid like hydrochloric (HCl), the ions of which (Cl) are able to form a stronger

(Continued on page 180)

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†Published April 1, 1952, by John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N.Y., price $12.50.

—And Says He WANTS MORE THOMAS DREDGE PUMPS

"In service nearly a year and good for several more month's operation."

Who says that? Not us. It is the USER of a Thomas Sand and Gravel Pump—Charles T. Turner of St. Francis Material Company, Forrest City, Arkansas.

Read Mr. Turner's letter, reproduced above. It is field-tested proof that Thomas Dredge Pumps last several times longer than conventional type pumps. *Result:* Less shutdown troubles, lower pumping costs, more material handled. *Reason:* Thomas Pumps are especially designed so they can be made of Ni-Hard, a special high abrasion-resistant metal.

Mr. Turner has had several years experience with pumps of other manufacture. Now after a thorough test of a Thomas Pump under practical operating conditions, he frankly says:

"Future pumps in our operation will be Thomas Pumps."

Mr. Turner's letter means that it will pay you to investigate a Thomas Pump for your own use. For prices and literature, write THOMAS FOUNDRIES, Inc., Post Office Box 1111, Birmingham 1, Alabama.

IF YOU DO IT WITH SAND & GRAVEL PUMPS, YOU CAN DO IT BETTER WITH A "THOMAS"

LABOR RELATIONS TRENDS

Office employes win a time clock and the court rebukes F.L.S.A. administrator

By NATHAN C. ROCKWOOD

THE CASE we are about to relate does not concern a rock products producer, but it is so typical of the way the U.S. Labor Department operates in pursuit of victims to harass under the Fair Labor Standards Act, that it is of interest, and possibly the outcome will prove helpful, to all employers of modest business enterprises. Moreover, it proves that even judges of the federal courts are becoming exasperated with some of the cases brought before them, and are willing to express a degree of sympathy for harassed businessmen. We will give the name and reference to the case at the end of this article for those who may want to make a record for possible use of their attorneys should they be caught under similar circumstances.

The company involved employed about an average of 100 production employes. It employed a varying number according to the season, from 55 to 120. Aside from the two principal owners or proprietors, the company's office work was done by a small staff of women or girls, also varying in number from 1 to 6. They each did the usual variety of clerical work from stenography, handling the mail, keeping the work time of themselves, etc. From the facts developed and stated by the judge in his decision, it is evident that this company operated on the informal, easy-going style common to many similar small business organizations. The production employes were not involved, because for them adequate time records were kept and they obviously worked by the hour and were compensated on a straight hourly basis for 40 hours a week with time-and-a-half for overtime as required by the F.L.S.A. Only the girl clerical staff was involved. That they were not underpaid by any standard is attested by the fact that five of them employed in December, 1951, drew a total of $310 a week, or better than $60 per week each.

The girls were hired individually as needed, with a guaranteed weekly salary based on considerably more than the legal hourly minimum plus time-and-a-half for any possible overtime they might be asked to work. If it required a few hours Saturdays to complete their week's work, they were expected to comply, but they never worked enough overtime to exhaust the salary they were paid on the basis noted. These employes understood the terms and apparently everyone was happy.

A 10-Year Old Injunction

Now we have to go back to September 14, 1942, when the administrator of the F.L.S.A. obtained an injunction against the company and its then president to obtain compliance with the law, which had apparently been violated more in ignorance than wilfully. Since then, according to the judge himself, the company had conscientiously tried to live up to the law. The president of the company had died in the meantime, and his heirs had carried on.

Almost 9 years later, in June, 1951, the local office of the U.S. Department of Labor received an *anonymous* letter to the effect that the company was violating the law in respect to its office employes. Incidentally, the 1942 court injunction had never been lifted. It is not common in our experience for anyone with a sense of decency to pay any attention to anonymous communications. Apparently this rule of etiquette does not apply to politicians and bureaucrats, for the Labor Department immediately hopped on the prospective victim. The legal division of the Labor Department made two "most searching and thorough investigations" of the records of the company in June and August, 1951, and came up with a petition to the U.S. District Court for a decision to hold the company and its two principals guilty of both criminal and civil contempt of the 1942 injunction. The charge of criminal contempt against the two individuals was dropped when it appeared that they were not active in the company in 1941, when the first case was brought. The whole case was based on the alleged lack of adequate payroll records in the case of 16 office girls, who had held jobs during the 10 intervening years.

From here on the text is that of the trial judge in his decision, with some omissions, where the details already noted are given:

The Judge Speaks

"It is the theory of the petitioner [the Secretary of Labor] that the nonexempt office employes were compensated on a salary basis with no additional compensation as to overtime for hours in excess of 40 in the workweek; that the hourly rates of pay set upon the payroll ledger of the company were fictitious and did not actually govern the compensation received by the employes; that each of the said employes worked more than 40 hours per week, and that they did not receive overtime compensation in accordance with the requirements of the injunction and the Act.

"Respondents contend, on the other hand, that the nonexempt office employes were employed at a bona fide hourly rate at all times equalling or exceeding the minimum hourly rate as provided by the Fair Labor Standards Act and were paid not less than one and one-half times their said hourly rate of pay for all hours of work in excess of forty during any one week; that said employes were guaranteed a certain number of hours of work per week for which they were paid, whether they worked that number of hours or not; that said office employes knew that they were employed upon an hourly rate and that they were guaranteed a minimum weekly wage, predicated upon an hourly rate with time and one-half for overtime, and that the employes knew these facts, understood the arrangement, and were satisfied with it. Respondents further contend that this was a legitimate arrangement not entered into with intent to defeat or evade the Act or the injunction but with the bona fide purpose and intent of complying therewith. While respondents concede that the time and payroll records for the nonexempt office employes do not in every case reflect the actual number of hours worked by the respective employes during the periods covered by said records, they contend that these inaccuracies constitute, at most, trivial, unintentional and technical violations of the law and of the injunction.

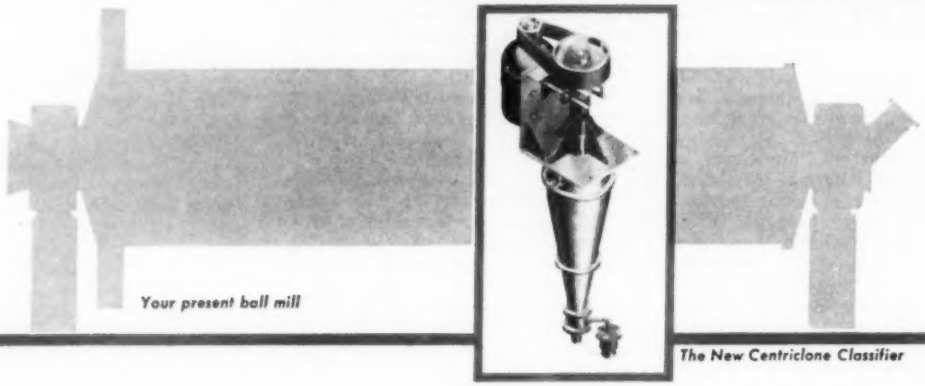
Guaranteed Weekly Wage

"The Court finds that each of the nonexempt office employes involved in this case was employed by the company at a bona fide hourly rate at all times equalling or exceeding the minimum hourly rate as provided by the Fair Labor Standards Act; that the contract of employment of each of such employes provided for compensation at an hourly rate, including time and one-half for overtime, that each of such employes was guaranteed by the company a certain number of hours of work per week and was paid for such hours at the agreed rate, including time and one-half for overtime, whether she actually worked the guaranteed number of hours or not; that each of such employes understood that she was being employed at an hourly rate of pay, as aforesaid; that each employe knew what her hourly rate of pay was, and was satisfied with the arrangement. That the guaranteed weekly wage of each employe was predicated upon an actual hourly rate of pay with time and one-half for overtime. The Court further finds that in certain cases such employes actually worked the full number of guaranteed hours; that they were always subject to being required to work the full number of guaranteed hours, and that they always worked such number of hours when it was necessary to complete the week's work. In no case did any of such employes work in excess of the guaranteed hours, nor did any employe do any work for which she was not compensated as required by the Act.

(Continued on page 184)

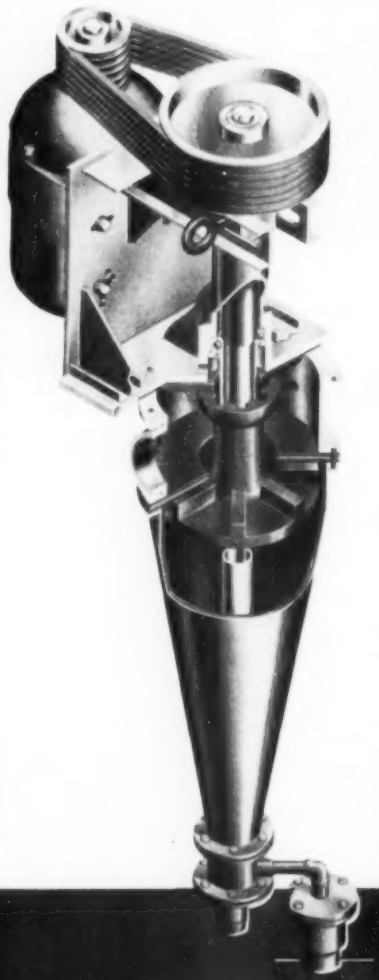
For Cement Manufacturers

HERE IS 25% ADDITIONAL GRINDING CAPACITY



Your present ball mill

The New Centriclone Classifier



The Centriclone Classifier can achieve a sizeable increase in the capacity of your present open circuit wet grinding. It is a new approach to the problem of creating a closed circuit. Centriclone accurately classifies the thick slurry as it comes from the ball mill, and gives a product comparable in water content to open circuit operation. The closed circuiting is achieved with utmost simplicity.

HERE ARE ACTUAL COMPARATIVE OPERATING FIGURES

This is a standard 7' x 26' Allis Chalmers Compeb Mill used for wet grinding of cement raw material in a California plant. It was originally operated in normal open circuit and was later closed circuited with the Centriclone Classifier.

	Open Circuit	*Closed Circuit with Centriclone
Product barrels/hour	74	100
Percent water in product	37.0	35.9
Percent + 200 Mesh in product	12.0	11.7
Largest particles in product	20 mesh	65 mesh

*Average for several weeks.

CENTRICLONE GIVES 6 IMPORTANT ADVANTAGES

1. **Lower Capital Investment** — The Centriclone Classifier costs less than 5% of the cost of the ball mill with which it operates — yet it steps up total capacity from 20 to 50%.
2. **Reduced grinding media consumption** — The increase in grinding capacity is achieved with lower ball and liner cost per barrel of cement.
3. **Lower water content** — Because there is less over-grinding of the fines, a higher slurry density is possible without increased viscosity.
4. **Power Economy** — The Centriclone requires only from 15 to 20 h.p. on a ball mill that uses a 600 h.p. motor. Total power per barrel is drastically reduced because you're not over-grinding the fines.
5. **Elimination of tramp oversize** — With Centriclone there is no kiln feed in the 20 to 50 mesh range.
6. **Simplified spitzer handling** — Only coarse protective screening is required; hence the quantity of spitzers is substantially reduced.

[illegible] ENGINEERS INC.

[illegible] STREET • SAN FRANCISCO 4, CALIFORNIA

PEOPLE in the news

P.C.A. Promotions

G. DONALD KENNEDY has been named vice-president of the Portland Cement Association, Chicago, Ill. He

G. Donald Kennedy

was formerly assistant to the president and consulting engineer. W. D. M. Allan, director of promotion, has been appointed vice-president for promotion, and Evelyn Pinkerton and J. L. Schneider have been made assistant secretaries.

Mr. Kennedy joined P.C.A. in 1950, after many years of experience in structural, municipal and highway engineering. A graduate of the University of Michigan, Mr. Kennedy served as state highway commissioner in Michigan and vice-president of the Automotive Safety Foundation before joining the association.

Mr. Allan is a veteran of 33 years with the Portland Cement Association. Following his graduation from Illinois State Teachers College, he joined the field promotion staff in 1918. Since that time he has served as manager of the Cement Products Bureau, director of promotion, and

W. D. M. Allan

secretary, which post he will retain.

Miss Pinkerton is the first woman officer in the history of the association. She joined the P.C.A. staff in 1933 and served for eight years as secretary to Frank T. Sheets, president of the association, who died last November.

Mr. Schneider, who joined the association in 1948, will continue as publications editor of the advertising and publication bureau in addition to his new duties.

Heads Mo-Kan Association

GEORGE W. KULHAVY, sales representative with Carter-Waters Corp., Kansas City, Mo., is the 1952 president of Mo-Kan Concrete Products Association. Born in Oxford Junction, Iowa, Mr. Kulhavy went to Kansas City in 1921, where he joined the Reliance Brick Co. In 1926 he became associated with United Brick and Tile Co., and later Cohn Building Materials Co. He was with Stewart Sand and Materials Co. from 1930 to 1935, at which time he joined the Carter-Waters Corp.

New Owner

LYNE A. PRICE is the new owner of Perma-Stone Dalls Co., Dallas, Texas. He has been associated with the firm as sales representative since 1945. Mr. Price set up the company's organization in the Southwest after serving previously as national sales manager for Perma-Stone.

Treasurer Retires

M. V. WARD, treasurer and chief accountant of Dewey Portland Cement Co., Kansas City, Mo., has retired after 32 years of service. His duties as auditor and office manager have been taken over by L. R. McDaniel. Mr. Ward has been succeeded as treasurer by Daniel W. Tyler, who will continue also as chief clerk in the sales department, which position he has held since the appointment of William L. Porter as director of safety for the Davenport, Iowa, and Dewey, Okla., plants. Mr. Tyler is the only son of Waldo E. Tyler, president of the company, and grandson of F. E. Tyler, chairman of the board.

Heads Pipe Firm

LLOYD R. EARL has been elected president of United Concrete Pipe Corp., Baldwin Park, Calif., subsidiary of United States Pipe and Foundry Co., Burlington, N.J. Mr. Earl was formerly vice-president of Consolidated Western Steel Corp.

Committee Chairman

FRED C. MALLERY, superintendent of the Luckey, Ohio, plant of National Gypsum Co., Buffalo, N.Y., has

Fred C. Mallery

been appointed chairman of the program committee of the Operating Division meeting of the National Lime Association, which will be held September 15-17 at Mountain Lake hotel, Mountain Lake, Va. Amos Miner, sales manager of the industrial division of National Gypsum Co., was previously appointed Operating Division chairman. One feature of the meeting will be a tour through National Gypsum Co.'s Kimballton, Va., lime plant and quarry, which is located only a few miles from the Mountain Lake hotel.

District Representative

W. H. LITTEER, traffic manager of The General Crushed Stone Co., Easton, Penn., has been appointed district representative in charge of sales of the Watertown, N.Y., office, in addition to his duties as traffic manager.

Wins Praise from Secretary Tobin

VINCENT P. AHEARN, executive secretary of the National Sand and Gravel Association, was commended by Maurice J. Tobin, Secretary of Labor, in a letter to Albert R. Shiely, president of the association, for his work as executive director of the President's Conference on Industrial Safety. Secretary Tobin expressed his gratitude to the association for its courtesy and cooperation in making available to the conference the invaluable services of Mr. Ahearn, and hoped that he would continue as executive director of the program.

Vincent J. Hanley

Leonard W. Saxby

Frank Moyle

Marquette Vice-Presidents

VINCENT J. HANLEY, secretary-treasurer, Leonard W. Saxby, assistant to the president, and Frank Moyle, director of operations, have been elected vice-presidents of Marquette Cement Manufacturing Co., Chicago, Ill.

Mr. Hanley, who was born and raised in LaSalle, Ill., joined Marquette in 1912 as a stenographer at the Oglesby, Ill., plant. After serving for a while in the timekeeping department he was transferred to the accounting department in the Chicago office and, in 1932, appointed assistant secretary, later becoming secretary and assistant treasurer. In 1943, he was elected secretary and treasurer. He will continue these duties under the title of vice-president.

Mr. Saxby's service with the company dates back 43 years, beginning as office boy at the Oglesby plant in 1908. He progressed through the stenographic department, shipping department to purchasing. Shortly after World War I he was made purchasing agent. In 1934 he was appointed assistant to the president. As vice-president he will continue to devote his attention to these duties.

Mr. Moyle, who is the son of one of the founders of Marquette Cement Manufacturing Co., the late Richard Moyle, Sr., trained for several years in various departments of the Oglesby plant before becoming a mill foreman in 1917. Two years later he was made assistant superintendent and, in 1925, superintendent of the plant. From there he progressed in 1933 to general superintendent of all Marquette plants. In 1946 he was appointed director of operations and will continue the duties of that office now as vice-president.

Resigns from W.S.B.

FREDERICK H. BULLEN has resigned as vice-chairman of the Wage Stabilization Board to accept a position with the firm of Kaye, Scholer, Fierman & Hays, New York corporation lawyers. Mr. Bullen is the son of M. E. Bullen, president of Fountain Sand and Gravel Co., Pueblo, Colo.

Sawyer Heads Lone Star

H. A. SAWYER, formerly vice-president in charge of the Louisiana division of Lone Star Cement Corp., New York, N.Y., was elected president of the company at a recent meeting of the board of directors. He succeeds R. A. Hummel who was elected chairman of the board and chief executive officer. Mr. Sawyer was also elected a member of the board of directors and of the executive committee. Th. Avnsoe was named vice-chairman of the board; R. J. Mahon, vice-president of sales; C. C. Van Zandt, vice-president of engineering; J. H. Mathis, vice-president and secretary, and J. W. Mather, vice-president of industrial relations. Officers re-elected were Erle V. Daveler, chairman of the executive committee; Rosser J. Coke, vice-president; J. H. Leikhim, vice-president and treasurer; A. C. Harragin, comptroller; and N. Pennicuik, assistant secretary and assistant comptroller.

H. A. Sawyer

Mr. Sawyer has been associated with Lone Star since 1925. Born in Texas in 1894, he attended public school in Fate, Texas, and preparatory school at Rockwell College, Rockwell, Texas. He graduated from A. and M. College of Texas in 1916 with a B.S. degree in civil engineering. After graduation, Mr. Sawyer held several engineering positions, and served as engineer officer throughout World War I. From 1919 to 1921, as agent of the State Department, he served as commissioner general, Republic of Liberia, in Africa. He returned to the United States to become associated with a highway engineering firm in Texas, followed by two years as field engineer with the Portland Cement Association. Joining Lone Star in 1925, he served in the Texas and New York offices until 1931, when he became vice-president and manager of the Louisiana division, New Orleans, La. He will be succeeded in this position by Warren F. Smith, division sales manager at New Orleans.

Mr. Sawyer has served as director of the Louisiana section, American Society of Civil Engineers, and was president of the society in 1937. He is also a member of the American Concrete Institute and the American Society for Testing Materials.

R. A. Hummel

OBITUARIES

JOHN RICE, SR., founder and honorary chairman of The General Crushed Stone Co., Easton, Penn., died recently at his home in Easton after a long illness. He was 85 years old. Born in Pottstown, Penn., Mr. Rice was graduated in 1885 from the Sheffield Scientific School at Yale University with the degree of bachelor of philosophy. For the first four years after graduation he worked as an engineer. In 1899, with the late Prof. James Madison Porter and the late Harry Mitchell, he founded The General Crushed Stone Co. He was the company's first vice-president, and in 1904 succeeded Professor Porter as president. He continued to serve in that capacity until 1931, when he became chairman of the board, and relinquished that post in 1951 when he was elected honorary chairman. In 1920 Mr. Rice was elected the second president of the National Crushed Stone Association which he helped to organize.

Mr. Rice is survived by two children, John Rice, Jr., vice-president of The General Crushed Stone Co., and Mrs. Pinkney Love, of Washington, D.C., and one grandchild.

HARRY E. JOHNSON, a retired farmer and gravel pit owner in Vandalia, Ohio, died recently at the age of 72.

MORTIMER DAVIDSON WANDELL, former president and director of New York Trap Rock Corp., New York, N.Y., died recently at his home in Pawling, N.Y., after a long illness. He was 77 years old. Mr. Wandell started his career in the crushed stone industry in 1899 with the Conklin & Foss Co., pioneers in large-scale crushed stone production. In 1918 he was elected vice-president in charge of sales of New York Trap Rock Corp., an incorporation of the Conklin & Foss Co., New York Trap Rock Co. and the Upper Hudson Stone Co. He became president and director in 1927 and retired in 1938 because of ill health.

Mortimer Davidson Wandell

Povl T. Lindhard

POVL T. LINDHARD, retired vice-president and chief engineer of F. L. Smidth & Co., New York, N.Y., and a prominent engineer in the cement industry, passed away recently at the age of 80. At the time of his death he was a director of the company. Mr. Lindhard joined F. L. Smidth & Co. in 1898 and retired in 1938. During that time he designed and equipped many cement plants and had over 40 patents to his credit. Among these was the Lindhard Kominuter, which is an improved ball mill. Another of his inventions was a mill combining a ball mill and tube mill in one unit, a forerunner of the present-day single mill with multiple compartments for both granulating and pulverizing. He also had many patents relating to pressure coolers, agitators, tube mill liners, water cooling of tube mills, and multiple cooling cylinders. Mr. Lindhard's engineering ability had an important influence on the development of the manufacturing end of the cement industry from its pioneer days to its present high level.

ERNEST H. HUMBERSTONE, former superintendent of Marble Cliff Quarries Co., Columbus, Ohio, died recently at the age of 64. He had been associated with the company for 31 years before his retirement in 1944.

ALAN B. WELLS, retired assistant treasurer and assistant secretary of Universal Atlas Cement Co., New York, N.Y., with which he was connected for 43 years, died recently at his home in East Orange, N.J. Born in Pittsburgh, Penn., Mr. Wells joined Universal Atlas in 1909 and was placed in charge of the accounting department in the Pittsburgh office. He became assistant credit manager in 1915 and assistant treasurer in 1930. He transferred to the New York office in 1936 and subsequently became assistant secretary. Mr. Wells retired in 1946.

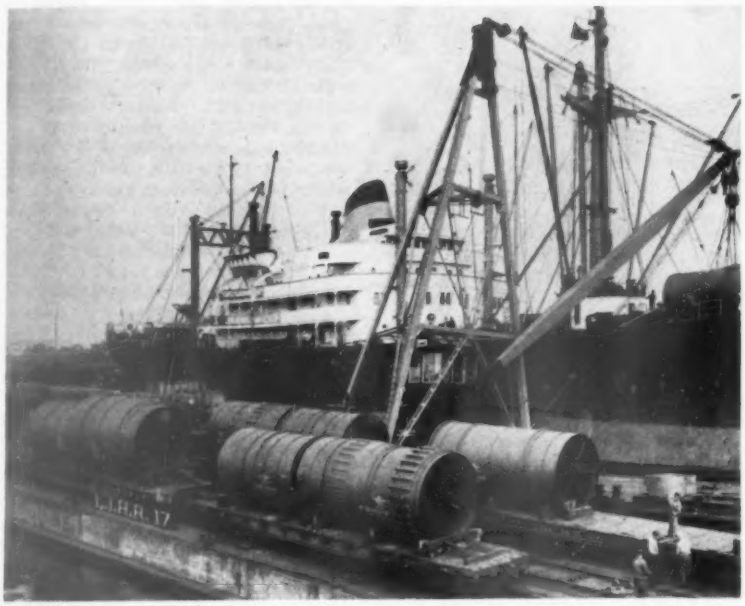
HENRY J. WARSAP, research consultant with the Blue Diamond Corp., Los Angeles, Calif., died recently. He was 91 years old. Mr. Warsap was a native of Plumsted, England, and as a young man opened a cement mill in Canada for the Canadian Pacific railroad. In 1902 he became manager of the Cia. Mexicana de Cemento Portland plant at Dublan, Mexico, which he converted to electric power in 10 years. Mr. Warsap joined the Blue Diamond Corp. in 1922 and was responsible for development of its research laboratory. He retired in 1949 but remained as consultant.

WALTER S. WING, retired vice-president of Penn-Dixie Cement Corp., New York, N.Y., died recently at the age of 67. Born in Detroit, Mich., Mr. Wing was graduated from the Engineering School of Cornell University in 1907. He began his professional career as a trainee of Carnegie Steel Corp., Pittsburgh, and joined the sales staff of Universal Portland Cement Co. in Pittsburgh in 1909. He advanced to sales manager but left the company in 1929 to join the Penn-Dixie Cement Corp.

THEODORE H. MERRIAM, former housing engineer with the Portland Cement Association, died recently at his home in Adrian, Mich. He was 53 years old. At the time of his death Mr. Merriam was a partner with C. S. Delamater in Central Gocorp, a concrete block machinery sales agency for the Gene Olsen Corp. Born in LaGrange, Ill., he was graduated from the University of Illinois in 1923. He was instructor in agricultural education at Rio Grande College and vocational agriculture at Rio Grande High School before joining the Portland Cement Association as field engineer in Chicago. Later he became housing engineer, remaining in this position until 1944 when he joined the sales department of the Stearns Manufacturing Co. In 1947 he became eastern representative and was in charge of the eastern office at Newark, N.J. After the controlling interest in the company changed hands, Mr. Merriam and C. S. Delamater became partners in Central Gocorp.

Theodore H. Merriam

industry news



Kiln shells, averaging 10 x 35 ft. for each section, are here being loaded at New York City for shipment to the Italian cement company, Italcementi

Cement Plants for Italy

A RECORD SHIPMENT of cement mill machinery has been completed for delivery in Trieste and Catania, Italy, as announced recently by Kennedy-Van Saun Manufacturing & Engineering Corp., New York, N.Y. The machinery, which was built for Italcementi, an Italian corporation operating over 30 cement plants, will equip two cement plants, each with a daily capacity of 300 metric tons.

Cement Strike Settlement

MEDUSA PORTLAND CEMENT CO., Cleveland, Ohio, recently resumed operations, following a 9-week strike at its plants in Silica and Bay Bridge, Ohio; Dixon, Ill.; Wampum and York, Penn.

In settlement of the strike, plant employes received a 10 cent per hr. wage increase; 2 cent increase for adjustment of inequities; six paid holidays, with double time if worked; 3-week paid vacations; and an increase from 4 and 6 to 6 and 9 cents an hr. in shift differentials.

Record Gravel Sales

AMERICAN AGGREGATES CORP., Greenville, Ohio, in its annual report to stockholders, stated that the corporation's 1951 operations set an all-time high record with respect to sales and net profit before taxes. Demand for its products was said to be greater than in 1950, despite government building restrictions, and production capacities at certain operations were inadequate to meet the increased demand.

The continuing increased demand in the markets served by the corporation necessitated the expansion of production facilities at all operations. Expenditures for this purpose approximated $1,400,000 in 1951. Stockholders were advised, however, that most of the earnings from the increased capacity would be absorbed by federal, state and local taxes.

Net sales in 1951 totaled $8,850,331, as against $5,815,246 in 1950. Net profit, after taxes, amounted to $1,235,793 in 1951, compared with $1,163,952 for the preceding year.

Asbestos Plant

ALONZO MINING & MILLING CO. is building a $250,000 asbestos processing plant in the Clear Creek area of Hermandez Valley, in southern San Benito county, Calif. The plant will produce approximately 1500 tons of finished asbestos monthly which will be shipped to the Philippine Islands under a government contract. Preparations for extensive development and mining of the deposits are currently being completed. Don F. Alonzo is president of the company.

Limestone Meeting

THE PROCESSED LIMESTONE ASSOCIATION held its summer meeting June 20, at the Findlay Country Club, Findlay, Ohio, as guests of National Lime and Stone Co. The association is organized for the promotion of soil conservation and the use of agricultural limestone. The meeting included a trip to Limestone Lake.

The following member companies were represented: J. E. Baker Co.; Basic Dolomite, Inc.; The Bluffton Stone Co.; Fayette Limestone Co.; Gibsonburg Lime Products Co.; J. M. Hamilton and Sons Co.; Kuenzli Quarries Co., Inc.; The Kelley Island Lime & Transport Co.; Marble Cliff Quarries Co.; Melvin Stone Co.; National Gypsum Co.; National Lime and Stone Co.; Ohio Hydrate and Supply Co.; Piqua Stone Products Co.; Plum Run Division of New York Coal Sales Co.; Tarbox-McCall Stone Co.; and Wyandot Dolomite, Inc.

Cement Used in Flotation Process

R. J. MORTON, Oliver Iron Mining Co., Duluth, Minn., has been issued a patent on the use of portland cement as a reagent in flotation of iron ores.

Cover Picture

The Kodachrome from which the cover of this issue was reproduced was taken especially for ROCK PRODUCTS. Bill Moyle, superintendent of Marquette's Brandon, Miss., plant, was pilot of the plane from which the photograph was taken, by professional photographer Bob Hand.

The plant is the first entirely new cement mill built by Marquette Cement Manufacturing Co. and is described in detail in this issue. In the foreground may be seen the slip tanks at the left, and to the right are the two kiln feed tanks with blending bins directly behind them. The packing plant is in the background to the right and the quarry (not visible) is about one-half mile to the left.

At the time the photograph was taken, landscaping and seeding of the property had just been undertaken.

"Out-of-Area" Cost Adjustments

OFFICE OF PRICE STABILIZATION, on June 18, issued Amendment 1 to Supplementary Regulation 66, General Ceiling Price Regulation, which permits ceiling price adjustments for dealers in sand, gravel and crushed stone and manufacturers of ready-mixed concrete, who are required to obtain sand, gravel and crushed stone from "out-of-area" sources of supply.

SR-66 originally provided ceiling price adjustments for dealers in cement and manufacturers of ready-mixed concrete who were required to procure cement from out-of-area sources. The amendment permits manufacturers of ready-mixed concrete and dealers to make similar adjustments for out-of-area purchases of sand, gravel and crushed stone. The new regulation became effective June 23.

The ceiling price increase granted by this amendment is limited to the actual additional costs incurred by the dealers and concrete manufacturers.

The term "sand, gravel and crushed stone," as used in the regulation, means these materials only when they are used as a concrete, masonry or plaster aggregate. "Out-of-area" was defined as the location of a source of supply of cement, or of sand, gravel and crushed stone, which is more distant, freightwise, than the most distant sources of supply from which cement, or sand, gravel and crushed stone, were secured during the calendar year 1950.

Celebrates Anniversary

PINE BLUFF SAND AND GRAVEL CO., Pine Bluff, Ark., recently celebrated its 39th anniversary in business by holding "open-house" at its newly-completed office building. Approximately 800 persons joined in the celebration. The company was founded in 1913 by the late W. P. McGeorge.

The company maintains a large fleet of river vessels which, since the early 1920's, has been listed with the U.S. government for use by the government when needed, to assist in combatting floods or in flood relief.

Officers of the company are W. P. McGeorge, Jr., president; Harvey Hogg, vice-president; Harvey McGeorge, secretary; and Theresa Scheu, treasurer and assistant secretary.

Employes Honored

MANITOWOC PORTLAND CEMENT CO., Manitowoc, Wis., recently held a banquet in honor of four of its employes who have completed 25 years of service with the company. Attending the celebration were all plant and office personnel as well as the head officials of Medusa Portland Cement Co., of which the Manitowoc company is a subsidiary. Visiting officials included J. B. John, chairman of the board; Ellery Sedgwick, president; P. G. Dawson, vice-president and treasurer; and W. J. Worthy, executive vice-president.

Gold watches were presented to Leo Groessel, Ernst Johnson, Jack Trotter and Joseph Pizar in recognition of their service record, which increases to 45 the number of employes who have received watches for 25 years or more service with Manitowoc Portland Cement Co.

Crushed Stone Meeting

THE NEW YORK STATE CRUSHED STONE ASSOCIATION recently held its midsummer meeting at Utica, N. Y., at which time problems and accomplishments of the industry were discussed. The program also included a tour of the Oriskany Falls, N. Y., plant and quarry of Eastern Rock Products, Inc.

At the board of directors meeting, Clifford C. Tobin, Ticonderoga, N. Y., was elected to succeed the late Harry R. Hayes, Albany, former Utica city engineer, as executive secretary and engineering director of the association.

Barge Terminal Approved

DEWEY PORTLAND CEMENT CO., Kansas City, Mo., has received permission from the Corps of Engineers to build a barge terminal at St. Paul, Minn. Cost of the project was estimated at $1,000,000.

Portland Cement Production

THE PORTLAND CEMENT INDUSTRY produced 21,829,000 bbl. of finished cement in May, 1952, as reported to the Bureau of Mines. This was a decrease of 0.4 percent compared with the output in May, 1951. Mill shipments totaled 23,282,000 bbl., a decrease of 6 percent from the May, 1951, figure, while stocks were 19 percent above the total for the same month in 1951. Clinker production during May, 1952, amounted to 21,044,000 bbl., a decrease of 1 percent compared with the corresponding month of the previous year. The output of finished cement during May, 1952, came from 150 plants located in 37 states and in Puerto Rico. During the same month of 1951, 21,924,000 bbl. were produced in 151 plants.

Utah Gypsum

THE UNIVERSITY OF UTAH'S bureau of economic and business research recently reported that reserves of gypsum in the Sigurd, Utah, area are estimated at 12,000,000 tons.

In a report on the state's gypsum industry, the bureau noted that Utah's gypsum products are chiefly lath, wallboard, building plaster and cement retarder. Utah also produces Keene's cement. Two gypsum firms, Western Gypsum Co., an affiliate of Certain-teed Products Corp., and United States Gypsum Co., operate plants near Sigurd, employing approximately 300 persons.

Coming Conventions

September 3-6, 1952—
American Institute of Mining and Metallurgical Engineers, Industrial Minerals Division, Fall Regional Meeting, Chicago, Ill.

September 10-12, 1952—
American Concrete Institute, Fall Regional Meeting (jointly with Structural Division, A.S.C.E.), Conrad Hilton Hotel, Chicago, Ill.

September 15-17, 1952—
National Lime Association, Operating Division, Mountain Lake Hotel, Mountain Lake (Giles Co.), Virginia

September 22-25, 1952—
American Mining Congress, Convention and Exposition, Public Auditorium, Denver, Colo.

September 29-30, 1952—
National Sand and Gravel Association, Semi-Annual Meeting of Board of Directors, New Ocean House, Swampscott, Mass.

October 20-24, 1952—
National Safety Congress and Exposition, Conrad Hilton, Congress, Morrison and Sheraton hotels, Chicago, Ill.

February 2-6, 1953—
National Crushed Stone Association, 36th Annual Convention, Hotel New Yorker, N.Y., N.Y.

February 23-26, 1953—
National Sand and Gravel Association, 37th Annual Convention, Fairmont Hotel, San Francisco, Calif.

National Ready Mixed Concrete Association, 23rd Annual Convention, Fairmont Hotel, San Francisco, Calif.

Buys Rock Wool Concern

PACIFIC MINERAL PRODUCTS, INC., Longview, Wash., formerly known as Carney-Pacific Rockwool Co., was recently purchased and reorganized by Tennessee Products & Chemical Corp., Nashville, Tenn., and Van Water & Rogers, Seattle, Wash. The Tennessee company will be in charge of plant operations and Van Water & Rogers in charge of sales.

The reorganization of the plant included an expansion in operating capacity and the addition of a new warehouse and office building. Further expansion and new products are now being planned.

Principal distribution points for the products are Seattle, Portland and Spokane. Both granular and batt insulation are produced. Officials of the new company include Nat Rogers, vice-president, Van Water & Rogers; M. H. Nabors, vice-president and general sales manager, Tennessee Products & Chemical Corp.; G. E. McElvain, Van Water & Rogers, in charge of industrial raw materials; and Harley Payne, in charge of sales.

To Buy Kaiser Gypsum

DIRECTORS OF PERMANENTE CEMENT Co., Oakland, Calif., recently voted to purchase the Kaiser Gypsum Division of Henry J. Kaiser Co., for a price approximating $5,412,000. The proposed purchase, if approved by stockholders, will be made by a new wholly-owned subsidiary of Permanente Cement Co., to be known as Kaiser Gypsum Co.

World's Largest Crusher

WHAT IS SAID to be the world's largest crusher is to be built by Allis-Chalmers Manufacturing Co., Milwaukee, Wis., for a taconite (low-grade iron ore) plant to be erected at Babbit, Minn., on the Mesabi Iron Range.

The crusher will weigh in excess of 1,225,000 lb., claimed to be 250,000 lb. heavier than any other crusher previously manufactured in the world. It will be driven by two 500-hp. motors. Four major steel castings will weigh 700,000 lb. and will vary in weight from 120,000 to 200,000 lb., with walls up to 8 in. thick. The main shaft, a steel forging approximately 27 ft. long, will weigh more than 100 tons and have a maximum diameter of 4½ ft. When in operation, the unit will be able to crush pieces of taconite 5 ft. in smallest dimension, down to 10 in. in size. Capacity of the crusher is 3500 tons of taconite per hr., which is said to be sufficient material, if crushed down to road stone, to provide a road 8 in. thick, 18 ft. wide and a mile long.

More than two years will be required to build the patterns, make castings and do the machine work on the unit.

Gilbert E. Olson, his wife, his son David, and his daughter Mary Ann board the plane at Phoenix, Ariz., on first lap of trip to Europe

European Travelers

GILBERT E. OLSON, vice-president and secretary-treasurer of Builders Supply Corp., Phoenix, Ariz., recently sailed on the Swedish liner Gripsholm, accompanied by his wife, his son David, and his daughter Mary Ann, for a three months' European stay. Mr. Olson's tour will take him to Sweden, Norway, Denmark, West Germany, France, Switzerland, and possibly England. He plans to bring back data which he hopes will lead to production of even lighter and stronger building materials than are now being turned out by the company. Mr. Olson reported that the Phoenix plant, with six Bessers, is turning out from 100,000 to 110,000 block per day, and that a research laboratory has been established at the plant under the direction of his son, Dr. George G. Olson, who has a doctor's degree in physical chemistry.

While in Stockholm, Mr. Olson plans on attending the National Home Builders Association meeting which is being held there to discuss the latest European building developments. Mr. Olson is a member of the association.

Research Center

NATIONAL GYPSUM Co., Buffalo, N.Y., plans to build a new research center, as was recently announced by Melvin H. Baker, chairman of the board. Construction is expected to be started early this fall and completed in the summer of 1953. Cost of the project is estimated at over $1,000,000.

National Gypsum Co. in the past few years has substantially increased its research facilities and personnel for the development of new products, improvement of existing products and development of new processes. The purpose of the new research center is to centralize these activities in one structure to be located in or near Buffalo.

Silver Anniversary

MORE SAND Co., Junction City, Kan., recently celebrated its 25th year in business. The company was organized by Roy More in May, 1927, and since that time has processed approximately 1,250,000 tons of sand and gravel. An extensive rebuilding program was started about five years ago and since then considerable new equipment has been added.

Sand and Gravel Plant

STANDARD PAVING & MATERIALS, LTD., Toronto, Canada, expended approximately $900,000 in 1951 on plant expansion. The major portion of this expenditure was for a new sand and gravel aggregate plant at Paris, Ont., operated under the name of Consolidated Sand and Gravel, Ltd., described elsewhere in this issue. Expenditures on plants and equipment for the past six years have amounted to more than $3,000,000.

The company reported a 23 percent gain in net profit for the fiscal year ended March 31, 1952.

International Symposium

AN INTERNATIONAL SYMPOSIUM on the Chemistry of Cement will be held in London, England, September 15-20, 1952. The papers to be presented will cover the following topics: the constitution of portland cement; setting and hardening of portland cement; special cements; and applications of research.

Research Laboratory

AMERICAN POTASH & CHEMICAL CORP. is establishing a $300,000 research laboratory in Whittier, Calif., it was recently announced by Peter Colefax, president. The new unit will supplement the present laboratory and pilot plant located at the company's principal site of operations at Trona, Calif. The new facilities are expected to be completed early in 1953.

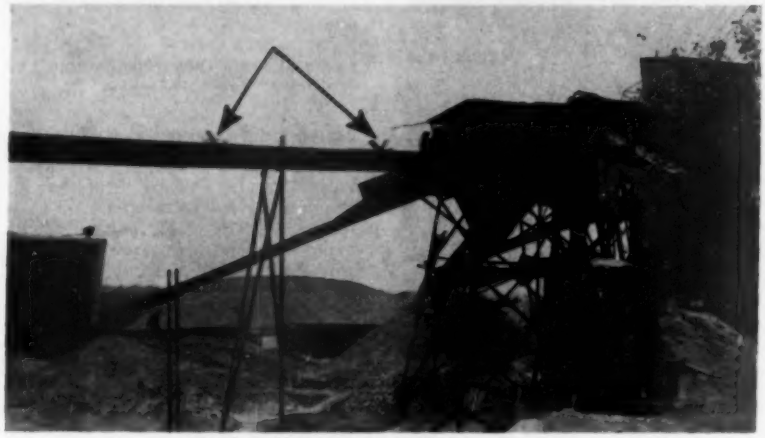
The company's research program is under the general supervision of D. S. Dinsmoor, vice-president in charge of research and development, aided by T. F. Edson, assistant vice-president of research and development. The new laboratory, as well as the Trona unit, will be under the direct supervision of W. A. Gale, director of research.

Pavement Yardage

AWARDS OF CONCRETE PAVEMENT for the month of June and for the first six months of 1952 are listed by the Portland Cement Association as follows:

	Sq. yd. awarded during June 1952	Sq. yd. awarded during first 6 months 1952
Roads	3,401,449	15,204,323
Streets and alleys	2,802,915	12,754,505
Airports	842,744	3,797,844
Totals	7,047,108	31,756,672

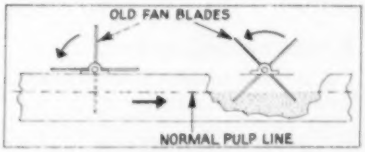
HH



Revolving blades prevent sanding-up in launder

Preventing Launder Sand-Up

AT A TEXAS sand and gravel operation, sand is recovered from settling boxes, but a considerable portion must be wasted. At the outlet from one of the sand boxes, the launder tended to sand up. To overcome this difficulty, two sets of old fan blades were



Line sketch showing installation of improvised waterwheel

bent slightly to give a waterwheel effect, with a bottom clearance of about ¼ in. Such blade assemblies, equipped with suitable bearings, were then mounted at the points of trouble. When a surge of pulp comes along, these little waterwheels start spinning and clear the bottom of the launder, and thus prevent any sanding-up.

Hard Facing Bucket Lips

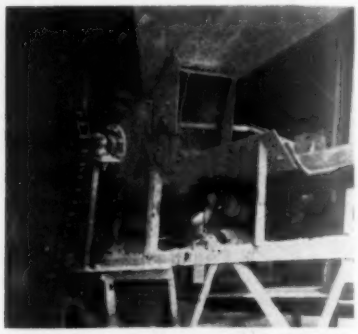
THE ACCOMPANYING ILLUSTRATION shows an all-welded steel bucket used in strip mining operations by a coal mining company. Lip and teeth are of cast manganese steel, riveted to the fabricated body. As a further protection against the scouring action of rock, earth and coal, the underside of the lip has been reinforced with a series of 16 parallel beads of Faceweld No. 12, a coated tubular arc welding electrode furnished by Lincoln Electric Co. This relatively new method of hard surfacing bucket lips is claimed to be economical and long-lasting. Operators claim the spaces between the beads fill up with excavated material, resulting in equivalent wear to that of a fully-coated

Underside lip of bucket is reinforced with 16 parallel beads, 2½ in. apart, extending plant vehicles, and for curing units

surface. The beads are 2½ in. apart and extend across the bottom of the lip and a third of the way up the sides, as shown in the inset.

Feeder Pulley

AT A TEXAS sand and gravel operation, the primary feeder under the truck hopper serving the plant is made of an old belt conveyor tail pulley and, in conjunction with a quad-

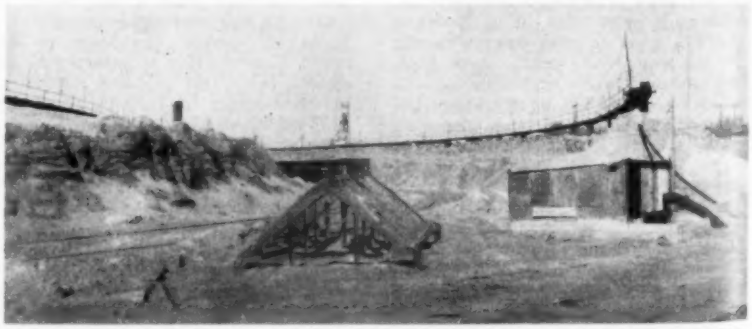


Primary feeder under truck hopper consists of an old belt conveyor tail pulley

rant-type gate, is mounted as shown in the illustration. The unit is driven by a length of roller chain from the offbearing tail pulley of the conveyor it feeds. The surface of the pulley is built up occasionally with a hard-surfacing welding rod to compensate for wear.

Eliminating Agstone Lumps

AT AN OPERATION in the Middlewest, agricultural limestone is processed by means of wet grinding. The agstone is settled out in large, specially designed settling areas which facilitate final drainage and drying. After the material is thoroughly drained, it is loaded into open gondolas by a clamshell. A V-shaped screen, of 3- to 4-in. mesh and of relatively light construction, is placed over the gondola. The crane dumps the agstone over this screen so that any lumps are broken up as the material is being loaded.



Agstone lumps are eliminated by placing V-shaped screen (shown in center) over gondola during loading process

Portable Shelter

AT A DISTRIBUTION YARD of an aggregate producer in the Mid-South, a portable shed was provided as shown in the illustration. The assembly, built mostly of used pipe, was mounted on four small diameter rubber tires. The shelter is provided

Portable cover offers protection for cars, plant vehicles, and for curing concrete units

with conventional electric lights and flood lights. The device is used when repairing trucks, tractors, etc., during cold or rainy weather. When not serving such purposes, the assembly is blocked up on concrete block and used as a shelter for autos. It can also be used as a shelter for curing concrete block or other concrete products.

Carrier Rolls

ON A SMALL BELT CONVEYOR system where a relatively light load was carried, the operators built their own carrier rolls as shown in the illustra-

Carrier rolls constructed from welding wire

tion. Two conical sections made of welding wire were butt-joined at the small ends. The end discs carry a shaft stub and act as the main support for the large end of each cone. Conventional roller bearings were used. All the conveyors in the plant were similarly constructed.

Left: Batching plant operator turns hand crank to elevate concrete orders from driver. Right: Ready-mixed concrete truck driver attaches order slips to belt by means of paper clips riveted to cotton belting

Hoisting Steel Members

CONSTRUCTION PROBLEMS relating to the elevating and placing of steel members were greatly simplified at the James River Hydrate & Supply Co. plant at Buchanan, Va., by use of a simple jig designed by a company employe. The jig will slip down over the top of upright columns, beams, pipe, or channels, and serves as an anchor to permit other members to be hoisted into place.

Construction of the jig consists of a 3-ft. section of 4-in. pipe, with three 2-ft. lengths of 1½ x 1½ x ¼ angle iron welded onto one end, permitting about 18 in. of the angles to project past the end of the pipe. The projecting lengths are so separated that they may slip over ends of various shapes and still fit snugly enough to provide a rigid support for a block or pulley necessary to hoist any further members or materials into position. Once used, it is said to be as easily removed as attached and may be moved to new positions.

Left: Construction of jig allows it to slip easily into position. Right: Jig hoists steel channels into position for welding

Ticket Order Transfer

ELEVATION of ready-mixed concrete batching order tickets from ground level to the batching station is accomplished by one producer with the simple, effective equipment shown. This consists of a 1-in. cotton belt on which clamp-type paper clips have been riveted every 18 in. In operation, the ready-mixed concrete truck driver clips the order slip to the belt. The batching operator can see any slips on the belt through the opening in the floor for the belt. He can then turn a geared-down hand crank to bring the orders to him.

Aggregate silo constructed of lightweight liner plates

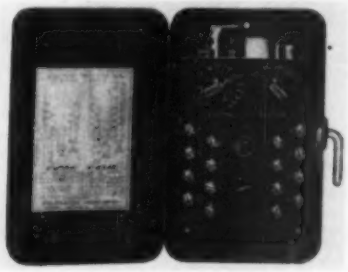
Aggregate Bin

STRONG, LIGHTWEIGHT liner plates, originally designed for tunnel construction, have been used by a midwestern quarry company for construction of an aggregate storage bin. The bin, shown in the illustration, is an aggregate silo, 30 ft. in dia. and 31½ ft. high. Bins of such construction may be erected in any season and can also be salvaged and re-used.

NEW Machinery

Automatic Timer

PHOTOSWITCH INCORPORATED, 77 Broadway, Cambridge 42, Mass., has announced the Photoswitch 30HL1,

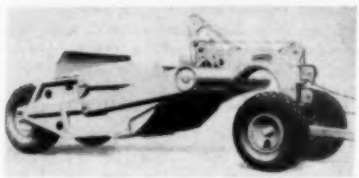


Electronic timer control

an automatic timer for intervals from 1/20 sec. to 4 min. It provides four basic types of timing: interval, delayed action, automatic repeat, and programming with variations. The basic electronic circuit is self-compensating for changes in line voltage and employs only one vacuum tube and one relay. It is equipped with two single-pole, double-throw switches and weighs 8 lb.

Scraper

CATERPILLAR TRACTOR CO., Peoria 8, Ill., has announced the improved No. 60 scraper for use with D6 tractor power. The unit has a flat-bottomed bowl and stinger blade engineered for loading and finishing characteristics. The reversible blade cuts a 7 ft. 8 in. swath; the bottom is double



Scraper with 7 cu. yd. capacity

with steel beam fillers. Capacity of the No. 60 has been increased to 7 cu. yd. struck and 9 cu. yd. heaped; maximum carrying capacity is 11.5 tons. Other design features include an unobstructed bowl, tapered roller bearings at the axles, induction hardened sheaves and bulldozer-type ejection. Operation is by means of a cable control attached to the tractor.

Front-End Loader

DROTT MANUFACTURING CORP., Milwaukee 12, Wis., has announced production of a new line of Drott Skid-Shovels, built for International tractors in the following models and capacities: TD-9, 1¼ cu. yd.; TD-14A, 2 cu. yd.; and TD-18A, 3 cu. yd. A patented feature called "break-out action" is said to give the bucket a

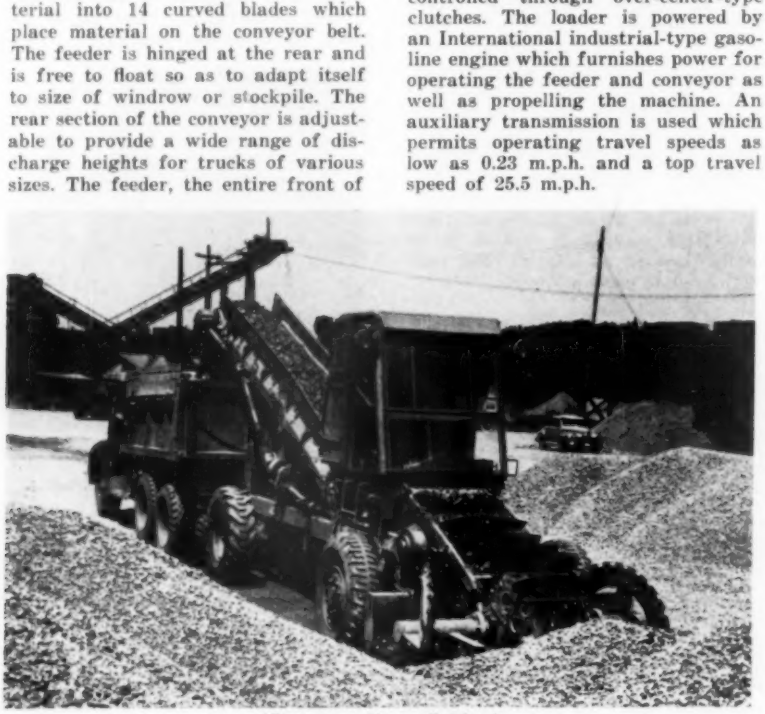
Hydraulic front-end loader

crowding action at every bite, assuring a heaped load. The force of this prying action is transmitted through the loader shoes into the ground. Loads are transported with the shoes skidding on the ground.

Another feature is the Hydro-Spring. A pressure line running from the main lift rams to the Hydro-Spring puts the hydraulic system under spring tension which is said to reduce hydraulic shocks. Action of the bucket control cylinders can be reversed by lever arrangement to provide greater power for digging and speed for dumping. A depth gauge indicator on the bucket control ram enables the operator to adjust the depth of cut to within a fraction of an inch.

Self-Propelled Belt-Type Loader

J. D. ADAMS MANUFACTURING CO., Indianapolis 6, Ind., has developed an all-purpose self-propelled loader, called the Traveloader. Spiral blades on the full-floating feeder work the material into 14 curved blades which place material on the conveyor belt. The feeder is hinged at the rear and is free to float so as to adapt itself to size of windrow or stockpile. The rear section of the conveyor is adjustable to provide a wide range of discharge heights for trucks of various sizes. The feeder, the entire front of the loader and the rear section of the conveyor may be raised or lowered through hydraulic controls from the operator's cab, and forward and reverse movements of these sections are controlled through over-center-type clutches. The loader is powered by an International industrial-type gasoline engine which furnishes power for operating the feeder and conveyor as well as propelling the machine. An auxiliary transmission is used which permits operating travel speeds as low as 0.23 m.p.h. and a top travel speed of 25.5 m.p.h.



All-purpose self-propelled loader

Color-Coded Hose

THERMOID CO., Trenton, N.J., has announced the consolidation of its molded hose line from 18 different types into five basic types, color-coded for identification according to use. New components used in the line include rayon braids of high tensile strength, and new tubes and covers of both natural and synthetic rubber. The five color-coded hose are called Versaflex, Versicon, Aquair, Utility and Powerflex.

Grease-type troughing roll assembly

Troughing Roll Assembly

UNIVERSAL ENGINEERING CORP., division of Pettibone Mulliken Corp., Cedar Rapids, Iowa, has developed a heavy-duty, grease-type troughing roll assembly for belt conveyors which features simplified greasing from one side, Timken bearings, and self-cleaning mounting brackets. Greasing is accomplished through readily accessible fittings with flexible automotive-type grease tubing carrying lubricant to middle and extreme end troughing roll bearings.

The rolls are mounted on self-cleaning brackets inclined at a 2½ deg. angle toward the flow of material to keep the conveyor belt in alignment. Extreme end bearings are protected by steel guards. The troughing rolls are available in 5 and 6 in. diameters, and in 18, 24, 30, 36 and 42 in. widths.

Engine Driven Welder

WESTINGHOUSE ELECTRIC CORP., Box 2099, Pittsburgh 20, Penn., has available a lightweight, compact engine-driven welder (Type EW-20). It can be equipped with complete engine accessories to provide 110 volt power. It has a nominal rating of 200 amperes, 40 volts, 60 percent duty cycle with current range from 40 to 250 amperes in accordance with N.E.M.A. standards. Coupled to a Ford "120" 4-cycle, 4-cylinder water-cooled industrial power unit, the self-excited, compound-wound generator functions both as a d-c generator and as a single-phase alternator for auxiliary power. Welding current is controlled by a tap switch and shunt field rheostat. The a-c circuit includes conventional outlets, a voltmeter, and a breaker with overload protection.

All-Wheel-Drive Trucks

MARMON-HERRINGTON CO., INC., Indianapolis 7, Ind., has brought out a completely new line of heavy-duty all-wheel-drive trucks, known as the "600" Series. There are five standard models in the line, with gasoline or diesel engines optional. Horsepower ranges are from 139 to 180; gross vehicle weights are from 24,000 lb. to 53,000 lb. The "600" Series has one of the roomiest cabs of any truck on the market, the manufacturer claims.

Torque Converter

CATERPILLAR TRACTOR CO., Peoria 8, Ill., announces that factory-installed torque converters can be provided for six sizes of its industrial engines. These torque converters allow the engines to maintain a continuously high output. Caterpillar diesel engines available with the torque converters range from 70 to 500 b.hp. and include the D397, D386, D337, D318 and D315. With these latter three engines, power can be delivered to the converters with or without a clutch, or with a clutch and reversing gear. Output arrangements include either a stub shaft or chain housing, the latter available in two sizes. All the torque converters mentioned are twin disc models that use ordinary diesel fuel as hydraulic fluid, making it possible to attach a charging device that draws from the engine fuel supply. An independent cooling system is also offered.

Drilling Unit

WORTHINGTON CORP., Harrison, N. J., has added an air-cooled compressor mounted on a crawler type tractor to its line of equipment. The unit is called the Uni-drill. Nine steel core V-belts drive the compressor. The drilling unit is a Worthington WD40 4-in. drill mounted on 12-ft. steel chain feed, attached to a special D-frame and fastened to the dozer trunnions of the tractor. A front cable unit raises it whenever a move is made. Two adjustable legs support most of the weight at the place of drilling and position is adjusted by a standard saddle clamp. A telescoping type back brace steadies the unit. Either wet or dry drilling can be accomplished with the unit.

Below: Drill fastened to dozer trunnions of a tractor. Inset: Air compressor unit

High-Compression Engine

GMC TRUCK & COACH DIV., General Motors Corp., 660 South Blvd., East, Pontiac 11, Mich., has announced a 302-cu. in., high-compression engine for use in the GMC 450 and 470 (2½ and 3 ton) model series trucks and tractors. The engine has a compression ratio of 7.2 to 1, said to be one of the highest of any standard gasoline truck engine, and generates 145 gross b. hp. at 3600 r.p.m.

Oil Filter

PERMANENT FILTER CORP., 2309 Riverside Drive, Los Angeles 39, Calif., has announced a permanent oil filter called the "Filterall." It is said to eliminate the need for cartridge pack replacements, and therefore will not cause loss of oil through the filtering element. It is about half the size of conventional oil filters and is built to be used in gasoline internal combustion engines. It consists of a permanent filtering element, constructed of sized, spherical-shaped bronze particles fused together. The oil filter allows all the oil to filter quickly and foreign matter as minute as five microns is filtered out, according to the manufacturer. It will not by-pass cold oil or absorb protective additives from the oil.

CEMENT INDUSTRY EXPANSION KEEPS PACE WITH NATION'S GROWTH

By BROR NORDBERG

Largest volume of increased production is from expansion of existing plants in effort to hold down investment per unit of output

Water transportation is becoming increasingly important in cement distribution. This vessel is fitted with air-activated gravity conveyors. It is one of three ships serving Great Lakes ports and the company is now fitting out a new ship with similar equipment

IN VIEW OF THE FACT that construction for the year 1952 is expected to decline some 10 to 15 percent from the total dollar volume of about $30 billion in 1951, according to authoritative advance predictions, it is surprising the amount of expansion and modernization that continues to be done by the portland cement industry. It has been estimated that the industry will have spent some $380,000,000 on 1951-1952 additions alone *(Wall Street Journal)* and that productive capacity will have reached 265,000,000 bbl. by the end of this year. After the current rearmament program is finished, the industry will be equipped to ship about 60,000,000 bbl. of cement more than could be shipped at capacity operations in 1949.

The building of new plants is being done when the investment per barrel of annual output is costing $10-$12 and even as high as $14 in one case, and when replacement and modernization are at a price 2½ to 3 times the original investment. Equipment prices reportedly are still on the upgrade.

Expansion has continued at a lively rate in spite of the great investment cost and during times when the prices for portland cement are extremely modest. The average national price for portland cement has increased only 61 percent over the 1939-1951 period as compared to 150 percent as the average for all building materials. These prices actually reflect depreciation charges applicable to plant facilities built years ago and the fact that many plants have been entirely depreciated. It is quite another thing to depreciate facilities at today's prices.

During the first few years following World War II, when cement was in short supply, the industry was being pressed hard for more cement capacity and has as a result increased its output to meet demands except for, possibly, a few local areas. In the last two years, when capital investment for plants has continued to increase, the industry has kept on expanding and modernizing at an accelerated rate.

There are a number of reasons for the continued investment to enlarge productive capacity. First, and probably foremost, the long range outlook for business is good, and particularly so for the next few years ahead. The population of the country is growing rapidly during times when the backlog for construction of practically all kinds is building to the biggest demand for construction in history.

At the present time, all forms of construction activity are in short supply except industrial building. Highway construction in particular has lagged and it has become evident that public pressure will soon bring about an accelerated program of road and highway building that will be unprecedented. Recent estimates indicate that expenditures for highways would have to approach $6 billion annually for a 15-year period to meet minimum

requirements, which compares with a $2 billion current outlay.

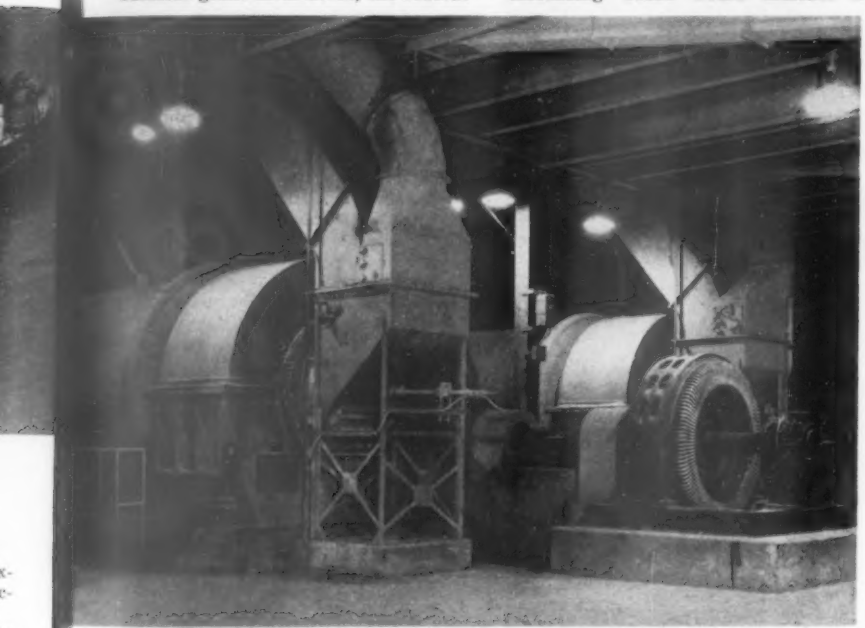
According to a survey by *Business Week* on general business and its expansion plans, industry is spending at the rate of $21.2 billion for plants and equipment in 1952, which is the largest in history, and has plans through 1955 which indicate expenditures very little under the 1951 level. Manufacturers will have increased productive capacity by 8.4 percent in 1952 and by 16 percent for 1951 and 1952 combined. Furthermore, it was reported that four out of five concerns have their own reserves and earnings set aside to pay for their expansion programs.

While it is expected that the level of business may decline temporarily when the accelerated rearmament spending is completed, until civilian business gains momentum, the federal government is holding some $7 billion of public works spending, for dams, veteran's hospitals, etc., in reserve in the eventuality of a decline after defense spending has ended.

If construction should decline moderately, as predicted, for 1952, there are those in the cement industry who do not expect as much of a decline in cement shipments. During recent years, cement has been getting a larger share of the construction dollar due to its favorable costs comparative with other materials and because of research that has gained wider acceptance for concrete. The fact that concrete block have superseded clay brick to a great extent, that concrete pipe continues to displace cast iron pipe, that concrete is being preferred to lumber and other building materials has shown up in the statistics. Furthermore, air-entrained concrete, prestressed concrete and other comparatively recent advances have reflected in increased use of cement.

According to Portland Cement Association figures, less than 15 bbl. of portland cement was required for each $1000 of construction in the 1925-1928 period whereas 20 bbl. was used in the 1946-1949 period on the average.

Due to the fact that military construction in general is of types that require more cement per unit of construction than the average construction for civilian purposes, it might well be that cement shipments for this entire year might approach or even equal the 1951 all-time record. At present, inventories in storage are increasing which would indicate a modest reduction by 1951 standards.



Discharge end of an air-swept raw grinding mill. This plant uses air-swept grinding mills, for both raw materials and the primary clinker circuit, in closed circuit with air classifiers and cyclones rather than the more conventional mechanical air separators

Most of the added capacity has come from expansion and improvement of existing plants rather than from entirely new plants, which have been relatively few. New plants have logically been located in areas of expanding markets and with a view to reducing shipping distances because of high transportation costs. Most of them have been established in the Southeast and the Southwest where there continues to be movement of industry and outlook for great expansion.

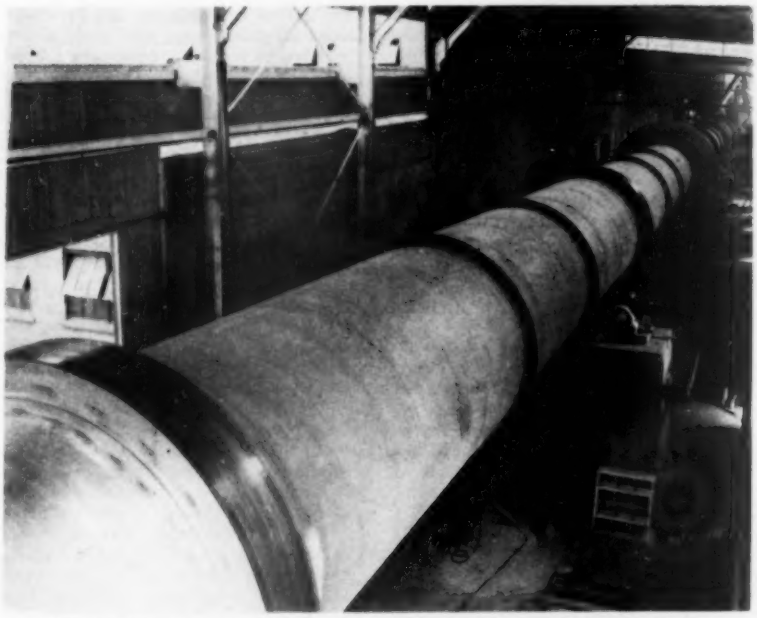
The theory of dispersal of plants geographically has not developed as far as it might have otherwise, because of the high costs of major expansion of operations. It is difficult for a new company to justify, under most circumstances, the high investment costs required to produce a product priced so low. Thus, the best possibility of expansion rests with companies which can merge current plant construction costs and income with an existing business to gain some decent return on the investment. That is the reason why all postwar new plants, with one exception, were built by existing cement companies. For the same reason, large capacity increases can be undertaken in existing plants at a much lower investment per unit of production than if a new plant were to be built. Some companies have materially increased output at a cost of $3½ or $4 per bbl., which serves their present purpose well even though necessary changes to unaffected production departments might have to come later.

Much of the large-scale replacements of old facilities, which adds to a considerable total, has been and continues to be made simply because existing facilities had become worn out. With replacement costs as high as they are, many of the replacement programs could not be justified on the basis of economics alone. The large investment demands a greater net income to justify the cost which is hard to realize from the cost savings attainable from the new equipment which must balance against higher depreciation costs. So, replacements are often dictated by necessity, when gains from volume cannot offset the higher costs plus the high taxes. Yet, if replacement and modernization were not done when required, the net income to carry on the business and pay the stockholders would suffer seriously. Oftentimes, developments dictate the replacement of equipment long before it has approached its normal life expectancy.

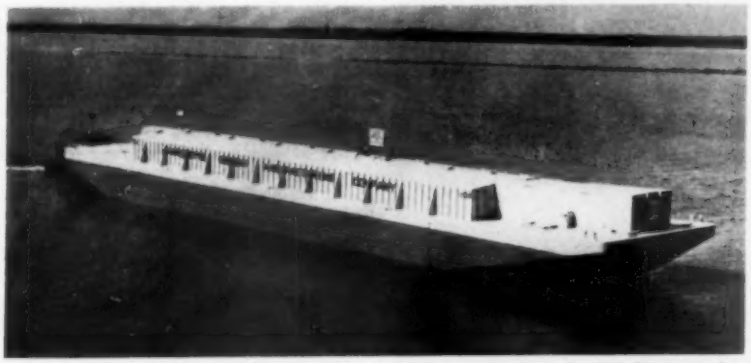
There are cement manufacturers who say that any large expansion is unjustified in view of the costs unless the company is able to secure a substantial Certificate of Necessity for accelerated amortization. Incidentally, a number of cement manufacturers have obtained such certification permitting accelerated amortization for a substantial part of the total cost over a five-year period.

Other than investment for large expansion of production as such, much of the funds being invested continues to be made for greater output from existing major production units, for the balancing of production throughout a mill and to reduce operating costs throughout. Emphasis has continued to be on the reduction of fuel costs more than any other single operation. Progress in cement manufacturing technology, as a result of all the investment since World War II, was summarized in ROCK PRODUCTS, January, 1952, pages 110-121.

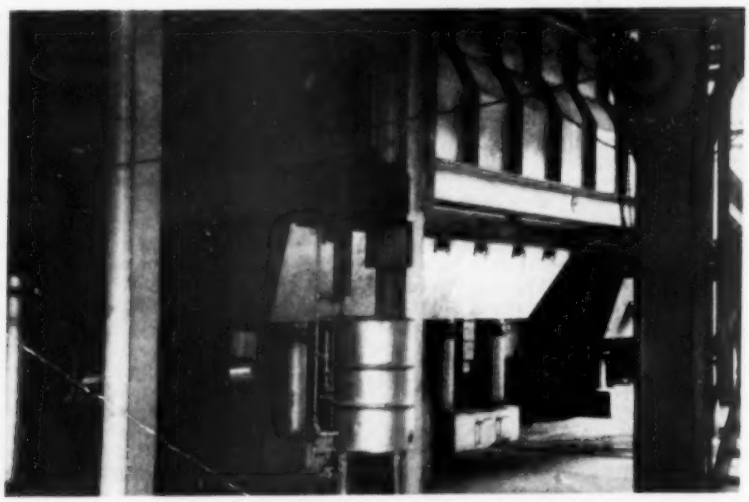
Quality of product and more adequate service to customers have also



This wet process 11- x 375-ft. kiln has tight kiln ends with air-quenching clinker coolers



Navigable waters are being used increasingly to transport cement from the manufacturing plant to distributing plants. Several companies have also inaugurated the practice of shipping clinker by water into cement-consuming areas to be ground into cement



One of three waste-heat boilers installed in a midwestern plant

figured in plans of the industry. There has continued to be a strong trend to more bulk cement shipments and to more truck deliveries in many areas. The great growth of the ready-mixed concrete and the concrete products industries has been responsible for much of this trend. A result has been the building of more bulk-loading and truck-loading facilities.

Several concerns have inaugurated the practice of shipping clinker into cement-consuming areas to be ground into cement, where low cost water transportation is available. There will be the establishment of more cement terminals on the navigable rivers according to reports from cement manufacturers.

Plant Expansion

One of our purposes here is to summarize the various expansion and modernization programs over the past five years and to enumerate programs being carried forward or contemplated. Accordingly, we addressed a letter to cement manufacturers and received replies from companies representing considerably more than half the output of the industry, which is greatly appreciated. The following is based on these letters, our own observations and other survey sources.

Oregon Portland Cement Co. completed its expansion program in 1947 just prior to the five-year date which we had established. The program increased capacity of the Oswego plant from about 1000 bbl. per day to 3300 bbl. per day.

Calaveras Cement Co., San Francisco, Calif., commented as follows:

"In 1946, Calaveras Cement Co. doubled its plant capacity with the installation of a third kiln, 11 ft. 3 in. x 360 ft., and related equipment. We are now in the process of completing our second major postwar expansion program at our San Andreas, Calif., plant. Our fourth kiln, which has the same dimensions as the one erected in 1946, is already in place and will be in operation some time during the third quarter of the year. Auxiliary equipment for the current enlargement includes four new cement silos and four new slurry silos, two additional 9- x 25-ft. mills, a new and larger stack, a third electric precipitator, a new cooler and another electric shovel. These capital improvements were purchased under a Certificate of Necessity from the government amounting to 70 percent of the estimated cost of $2,235,106. Our latest expansion will increase our plant capacity 50 percent to 3,750,000 bbl.

"This construction program was undertaken on the basis of our own market studies forecasting higher cement sales in northern California. Our second important objective was to increase manufacturing efficiency through modernization of facilities. During the past two summers cement

was in very short supply in this area. Although we are still optimistic about the demand for cement, we do not anticipate any further shortages in the immediate future. Current inventories of cement plus our augmented production by the end of this summer should take care of the demand for this year's construction season and probably for the next few years as well. Accordingly, we have no present plans for additional plant expansion in the near future."

A midwestern company with a single plant, which had not undergone improvement and enlargement in many years, is spending $1,000,000 to replace worn-out equipment and to increase capacity by 20 percent. The expenditure was motivated by the company's confidence in the growing use of portland cement and expanding demand.

Federal Portland Cement Co., Buffalo, N.Y., which installed a 375-ft. wet process kiln in 1951, is contemplating changes as follows:

"We are expecting to increase our silo capacity for finished cement, and are presently asking for bids on four silos of a total capacity of 64,000 bbl., which are designed primarily for loading trucks. They are not attached to any of the other silos which we have, but are set apart for this particular service. This is the only major construction which we contemplate.

"Since our installation of the new kiln and wet grinding mill last year, we put a hammermill ahead of the grinding mill to increase capacity. The only other important change made since the new kiln was put in service was a change to a combination Multiclone and wet washer to clean the gases before entering the stack. The wet washer is in service and the Multiclone is on hand and will be installed at our convenience."

Lone Star Cement Corp. completed two new dry process plants in 1951. The Lone Star, Va., plant was described in ROCK PRODUCTS, August, 1951, and the Maryneal, Texas, plant is described in this issue. The corporation commented as follows:

"During the five years, 1947 to 1951 inclusive, our company completed the following major additions:

A fourth kiln installed at our New Orleans, La., plant;

A fourth kiln installed at our Dallas, Texas plant;

Kilns No. 4 and 5 extended and enlarged at our Nazareth, Penn., plant.

"Two complete new plants were placed in operation—one at Lone Star, Va., in May, 1951; and one at Maryneal, Texas, in December of the same year, each with an annual capacity of 1,500,000 bbl.

"These improvements increased the productive capacity of domestic Lone Star plants by approximately 5,400,000 bbl. per annum.

"In addition, there were other improvements to manufacturing facilities in all departments which, of course, contribute to maximum output in all of our domestic plants.

"The basis of our construction and modernization program was planned prior to the five-year period outlined by you, so that the peak in this direction has been reached, although the policy of maintaining all plants in first-class condition, with modern equipment facilities, will be continued whenever and wherever the economics of the situation justify it."

Riverside Cement Co., Los Angeles, Calif.:

"Since the end of World War II, this company's Oro Grande plant has been completely rebuilt and modernized including the installation of five new 10- x 350-ft. kilns, six new Tyrax raw ball mills, new second and third reduction crushers, new finish end, new finish silos, etc. The capacity of the plant has been increased by nearly 4,000,000 bbl. annually.

"The two major objectives of the construction during the past five years at Oro Grande were: (a) increased capacity, (b) lower costs.

"Fortunately, the great bulk of the expansion at Oro Grande was completed immediately postwar at unusually low cost for the capital equipment for this postwar period. These

Above is an artist's conception of how Calaveras Cement Co.'s San Andreas, Calif., plant will look when present expansion is completed. The company is now completing the second major postwar expansion program at the plant, which will increase plant capacity about 50 percent

relatively low costs resulted partially from timing and partially from the development by our engineering department of a design for the installation which lent itself to relatively low cost.

"The plant improvement at Oro Grande is substantially complete as of this month."

Ideal Cement Co., Denver, Colo., was one of the first major concerns to launch a large postwar scale expansion program. It is summarized in the following:

"Ideal Cement Co. by the close of the present year will have completed a $32,000,000 capital program starting early in 1946. This program included principally the following items:

"1. A new cement plant with approximately 1,500,000 bbl. annual capacity at Portland, Colo. (where we had already had an existing plant for 40 years).

"2. An exact duplicate of the above at Devil's Slide, Utah (where we also had had a cement plant for about 40 years).

"3. A new cement plant (converted from an alumina sintering plant) at Mobile, Ala. This is a totally new location for production of cement. The plant was put into operation in the fall of 1946.

"4. A totally new cement plant at Baton Rouge, La. This location was purchased in 1950 and the plant started in October, 1951. No cement plant had been at this location before.

"5. A bulk terminal at New Orleans, La.

"6. Extensive modifications and a 35 percent increase in capacity at our plant at Ada, Okla.

"7. A complete finish grinding department at Superior, Neb.

"8. A complete finish grinding department at Trident, Mont.

"9. A new kiln adding 50 percent to our productive capacity at Trident, Mont.

"We feel that our plants and properties are now in good condition and probably adequate to take care of any reasonable demands for cement that might be put upon us in the years immediately ahead.

"The expansion plans which we have outlined are to provide additional cement in areas where our customers were badly in need of it. We do not attempt to speak with any authority on the expansion program of other companies or the industry as a whole, although we do think that there is going to be more cement used in the future than there has been in the past, for the reason that it has been demonstrating its superiority as a building material in many ways in the past eight or ten years when other competitive materials have been hard to get and cement was used as a substitute. In other words, new uses are being found for an old material.

"Speaking for our own company, fortunately for us the first two-thirds of our program, approximately $20,000,000, was done at a time when costs were much lower than they are now, that is, prior to 1949. In our most recent program involving a total of approximately $12,000,000 a necessity certificate giving us a five year write-off on 70 percent of $10,000,000 of the total was received. Only by this means would we have been willing to venture the capital required, as otherwise the tax situation is such that there would be little hope of recovering the investment within anything like a normal period.

"Early in 1952 the Ideal Co. adopted the policy of completing all of its authorized work and not taking anything new in the way of capital outlay until something more definite in the way of economic trends could be ascertained. The completion of our program for this year involves the outlay of approximately $3,000,000 and covers principally the following items:

"1. At Baton Rouge, La., the installation and completion of the fourth kiln in the new plant. Also the completion of the waterfront installation on the Mississippi river which because of high water could not be started until June of this year.

"2. At Mobile, Ala., we are replacing the tubular coolers, which were a part of the plant when we acquired it, with Allis-Chalmers vibrating type.

"3. We might also tell you that our board has authorized the construction of a research building to be located at our Boettcher, Colo., plant, and that we do expect to expand our research effort considerably in the immediate future."

Northwestern Portland Cement Co., Seattle, Wash.:

"We have installed a new tramway system at our plant at Grotto in connection with opening up a new quarry. We have had no appreciable increase in our capacity. We have no expansion plans for the immediate years ahead."

Glens Falls Portland Cement Co., Glens Falls, N.Y.:

"We have in the last five years increased our capacity 25 percent by making many minor changes in our operation which have led to greater efficiency."

An eastern manufacturer with several plants:

"During the past few years, at one of our plants, we have constructed three large rotary kilns to replace obsolete and obsolescent kilns; two new aerating tanks for raw materials have been installed; we have added two new clinker coolers and new clinker conveying equipment; we now have facilities for burning a mixture of anthracite and bituminous coal. These improvements have been made in the interests of modernization and lower production costs; so far as production is concerned our capacity is some 400,000 bbl. less than formerly.

"At our other plant, we have recently started the operation of a new kiln which gives us an increased potential capacity of 600,000 bbl. annually, 50 percent greater than heretofore. In our clinker burning operations we have converted from coal to oil, although we can use either as seems expedient.

"At one plant we have plans for complete new storage and blending silos for raw materials; also a new raw and finish grinding department. No major alterations or additions are planned for the second at the moment.

"The new installations and modernization at the latter plant are in the interests of efficiency of operation, and also because of the increasing demand for cement in the area served by that mill."

Dust collection has received considerable attention in recent years. Here is an electrical precipitator installation for collection of dust from stack gases

Huron Portland Cement Co. has expanded its Alpena, Mich., plant capacity considerably during the past few years and is now planning future projects. By adding new kilns and increasing grinding equipment, the company anticipates raising its capacity about 2,000,000 bbl. annually

Columbia-Southern Chemical Corp. (subsidiary of Pittsburgh Plate Glass Co.):

"Our only project at the cement division is the change-over from quarry to the underground mining of limestone. This is necessary because our quarry is approaching the end of its useful life.

"This project is estimated to cost about $1,500,000 over the next three or four years. It involves no increased capacity, and we do not have any plans for expansion."

An eastern company with a single plant:

"During the past five years we have modernized and expanded our finish grinding department by the addition of Bradley Hercules mills as preliminary grinding units and addition of air separators, all designed to reduce operating costs and increase capacity. We are producing portland blast furnace slag cement, using granulated blast furnace slag to supplement our clinker production. By this means of increasing our capacity in finish grinding, we have been able to add approximately one-third to our finish cement capacity as compared to five years ago.

"Our major objective in this expansion program has been to increase our capacity of finished cement with a minimum of capital investment."

A company in the East with a single plant:

"Your interesting letter of June 25th appraises the matter of providing increased capacity for the cement industry as though there was an exercisable choice whether or not to expand. As far as I am concerned, there is no choice. Foreseeable increases in the use of cement will require further capacity increases. Higher fuel and labor rates dictate better use of fuel and labor. So far as I know this can be accomplished only through the replacement of small kilns and mills with large, modern units.

"If this viewpoint is only reasonably correct, we are just entering the period of modernization and are probably no more than half through the period of expansion."

One of the smaller western concerns:

"This fall we expect to complete the installation of additional equipment which will a little more than double our former capacity. It is my opinion that most of the additions made to existing plants have been made for the main purpose of improving plant efficiency and secondly to take care of the natural growth of business. I would think that, as in our case, most of the programs were considered to be too late, but have been carried on with the idea that costs would not decrease."

Huron Portland Cement Co., Detroit, Mich.:

"There is little that we can add about Huron that you have not already very ably covered in your articles of recent months. Our construction during 1951 was little more than the windup of the projects which you covered in your article of January, 1951. Also, we wrote you in De-

cember, 1951, telling you of our anticipated projects, namely, four new kilns at Alpena, Mich., thereby raising our capacity approximately 2,000,000 bbl. annually. Along with this there will be a considerable increase in equipment for grinding, particularly on the finish end whereby we will add 10,000 bbl. a day to the grind, which is currently running about 25,000 bbl. average at Alpena and 2500 at Superior.

"In brief, we have added six kilns, as you know, in the past five years and have increased our production by virtue of the new kilns and other improvements in machines and methods so that the 90 percent increase that you mentioned in your January, 1951, article is borne out in fact and we are running currently at a safe load of 600,000 bbl. a month from our kilns.

"The new vessel, M/V Paul H. Townsend, is at the Hoboken yard of the Bethlehem Shipbuilding Co., where she is being rebuilt for the cement trade, using the same air conveyor system that has worked out so satisfactorily on the steamer Samuel Mitchell. She will be brought to the Great Lakes this fall.

"Our quarry modernization project is progressing slowly and should be completed for operation in the spring of 1953. We have not yet succeeded in getting a permit to build from N.P.A. for the additional four kilns but continue to press for authority. This means that to date we have let no contract on this phase of our expansion but will do so as soon as permit is issued.

"Along with this phase of our expansion project, we will have to relocate our clinker storages and step entirely outside of current structures for the addition of new mills. This means that this part of our growth will be somewhat greater per barrel cost because up to date, due to the remarkable foresight of those who went before us, we have had little to do with conveyances, storages, scales, etc., and have had in each department adjacent areas where the new machinery could be set in. This speaks well for the forward thinking of J. B. Ford, S. T. Crapo and W. P. Harris, all now deceased, that they would build a plant and allow 90 percent increase without any great distortion or straining of existing facilities.

"From this point on, our costs per barrel of addition or improvement will undoubtedly be somewhat higher. However, we still have pretty good groundwork at Alpena on which to build, particularly in the matter of finished cement storage, boat loading capacity, etc. Projects anticipated for 1952 and extending probably over the next three years should run in the neighborhood of $7,500,000. This will include the cost of reconstruction of the new ship, although her original purchase was in the figure that I gave you above. It will include the completion of the work at the shale pit, relocation of our clinker storages, some expansion of storages at our distributing plants and an entirely new finish grind building, complete with mills, and, of course, the addition of the four new kilns with the necessary cold mills, storages, boilers, precipitators, etc.

"So much for our construction program. Now you ask for opinions on general conditions, such as purpose for current expansion, whether or not the industry is being over-expanded and justification for building under such high cost conditions. We are always reluctant to get into the matter of general economic conditions or to speculate too much on the other fellow's necessity or predilections. We assume, however, that other companies feel very much as we do about the matter. We would not spend one additional penny for expansion at this time were it not that we feel a certain responsibility to our customers and regardless of the information upon which D.P.A. and N.P.A. see fit to deny us authority to build, we know that in our area at least, there is a definite under-capacity to supply the current demand. One guess is as good as another on the question whether or not the present unprecedented demand is simply a flash and will soon drop off to a

Efficient handling of material is necessary in all phases of cement manufacture. This view of a kiln from the firing end shows a constant head air-lift feeder on the left

point where current production will be ample. Certainly, we have thought this very thing for some two or three years now and the pressure on us has increased rather than decreased. So far as Huron is concerned, we feel that we should continue a modest expansion program."

Canadian cement production has been boosted substantially during the past five years. One plant has had its production capacity increased by 1,200,000 bbl. per year to 6,000,000 bbl. by installation of an additional kiln. A 450-ft. kiln has brought production up to 2,600,000 bbl. at another plant and a third kiln will add another 1,200,000 bbl. later this year. At still another plant, capacity has been doubled to 1,600,000 bbl. by a second kiln and a third kiln will bring its capacity to 2,800,000 bbl. by the end of this year.

A new plant at Havelock, New Brunswick, was built to produce 800,000 bbl. annually. The Newfoundland government has built a 600,000 bbl. plant at Cornerbrook. Another plant in Ontario is increasing production from 1,500,000 bbl. to 2,225,000 bbl. and one in the West is being enlarged from 1,300,000 bbl. to 2,000,000 bbl. annually.

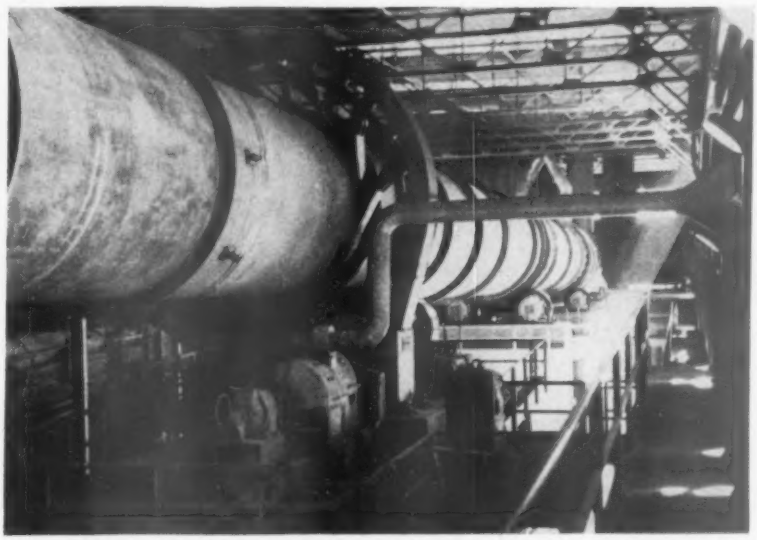
A California plant:

"Modernization and expansion or construction programs completed during the past five years would amount to approximately $9,500,000, of which a total of approximately $7,000,000 has been spent for the construction and expansion of the plant of a wholly owned subsidiary, which now has an annual capacity of 1,500,000 bbl.; and $2,500,000 has been spent for the modernization and expansion of the company's older plant, resulting in an increase in annual capacity of about 500,000 bbl.

"Expansion in both plants provided additional production for the markets. Most of the expenditure at the older plant was for modernization. We expect to spend an additional $2,000,000, approximately, for further improvements at this plant within the next year and a half."

One of the most comprehensive programs involving distribution as well as expansion has been accomplished by **Permanente Cement Co.** of California which now is set up to serve the entire West Coast, Alaska and the Pacific islands, which area consumed in excess of 36,000,000 bbl. in 1951.

In 1947, the company acquired a 58,000 bbl. bulk cement ship and increased clinker capacity by more than 250,000 bbl. with installation of inclined grate clinker coolers. In the 1948-1950 period, modernization resulted in increasing capacity by 350,000 bbl. of cement and, during those years, distributing plants were established at Anchorage and Fairbanks, Alaska. In 1951, capacity was increased by 1,400,000 bbl. when a fifth 450-ft. rotary kiln was installed



A separate fan was provided in this installation to insure kiln drive motor against overheating

resulting in a total capacity of 7,000,000 bbl. of cement annually. Capacity of the Seattle, Wash., distributing plant was increased, and distributing plants were purchased and enlarged at both Portland, Ore., and Long Beach, Calif. A second bulk cement ship, of 40,000 bbl. capacity, was also added. Total investment during the five-year period was $10,582,000.

With already established distributing plants at Redwood City, Calif., and Honolulu in the Hawaiian Islands, the company has storage capacity totalling almost 1,000,000 bbl. in order to serve the entire Pacific Coast and the Pacific islands.

This program is Permanente's answer to the high cost of plant facilities. With one large centrally located cement manufacturing plant and a chain of distributing plants, it has attained the advantage of multiple plants at somewhat less than one-half the cost, comparatively.

Marquette Cement Manufacturing Co. has materially increased productive capacity, principally by installation of a second 475-ft. rotary kiln at Des Moines, Iowa, and the new Brandon, Miss., plant which we describe in this issue. The company's rated productive capacity is now 10,750,000 bbl. of cement annually. Among plans under consideration are the revamping of shipping plants and dock structures, a rail-river transfer at Vicksburg, Miss., a shipping plant in Chicago and some rebuilding at other manufacturing plants.

According to published reports, **Lehigh Portland Cement Co.**, Allentown, Penn., spent $12,000,000 in 1949 and 1950 which resulted in increasing production 9 percent to 21,000,000 bbl. of cement per year. The company's new plant at Bunnell, Fla., which has two 10½- x 380-ft. rotary kilns, will begin full production this fall to add 1,400,000 bbl. productive capacity. Among plans for 1953 and 1954 are a new plant at Monticello, Minn., doubling of the Alsen, N.Y., plant and modernization at Fogelsville, Penn.

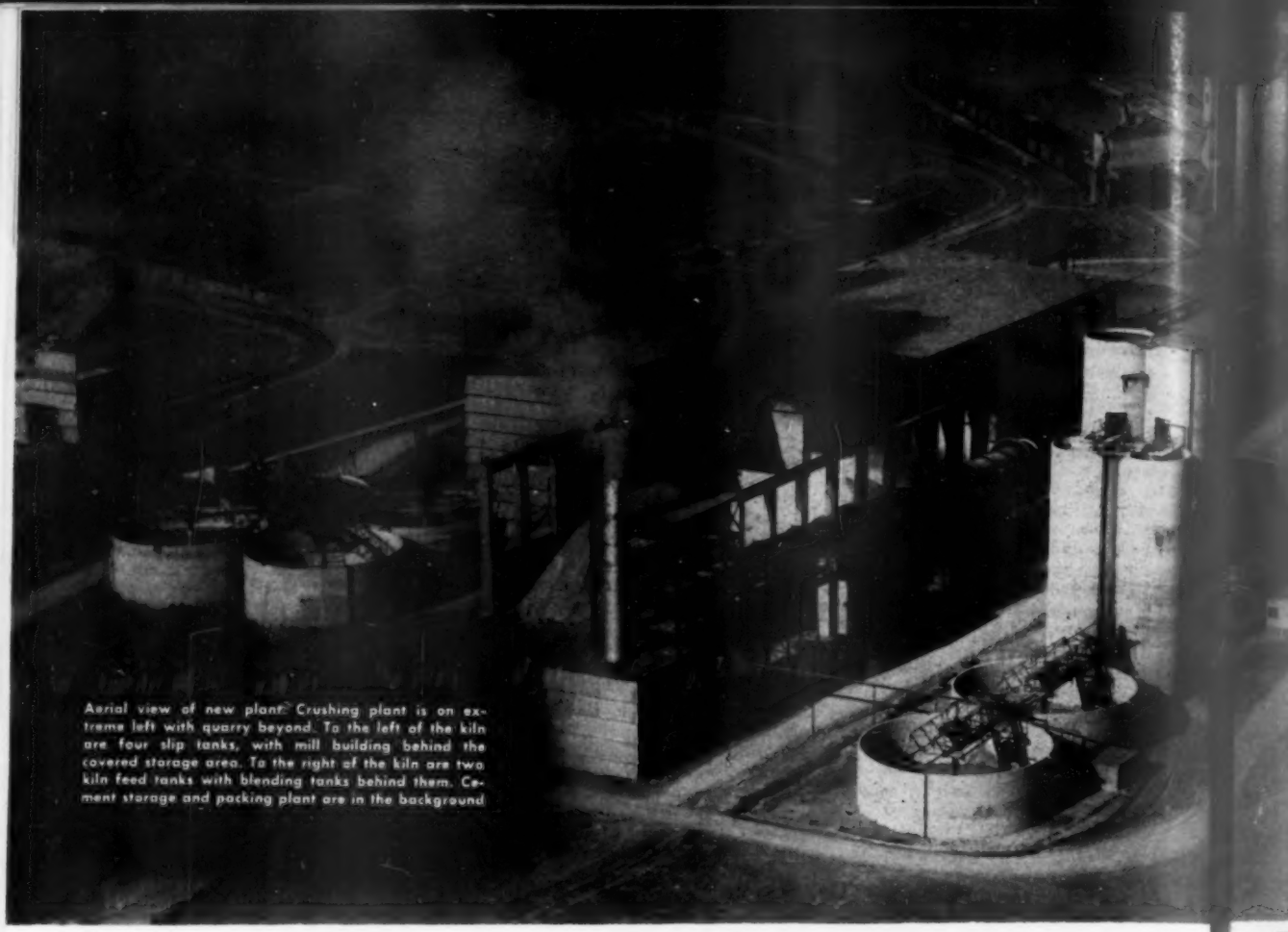
Alpha Portland Cement Co., Easton, Penn., is in the midst of a three-year $6,000,000 program affecting several plants which is scheduled for completion by the end of 1953. **Medusa Portland Cement Co.**, Cleveland, Ohio, is spending an equivalent amount for a 12 percent increase in production capacity.

Peerless Cement Corp., Detroit, Mich., has doubled clinker capacity of the Port Huron, Mich., mill with a second 11- x 400-ft. rotary kiln, is shipping clinker from the plant by water to be ground in the Detroit plant and has enlarged output from the latter mill by a series of improvements.

One of the Michigan plants is developing a new limestone quarry at a cost of $640,000. **Hercules Cement Corp.**, Philadelphia, Penn., has a program underway involving, principally, two rotary kilns of 1,000,000 bbl. capacity each.

A new plant of 1,250,000 bbl. capacity is to go into production soon at Tampa, Fla., and about $6,000,000 is being spent in developing a 1,800,000 bbl. plant in the Southeast.

Among other concerns which replied to our letter, only a very few indicated that they had not recently expanded production or had plans for enlargement. The rest told of modernization programs being carried forward which have resulted in modest increases in capacity in the range of 25 percent, or which are strictly for the purpose of improved efficiency and affecting all productive departments.



Aerial view of new plant. Crushing plant is on extreme left with quarry beyond. To the left of the kiln are four slip tanks, with mill building behind the covered storage area. To the right of the kiln are two kiln feed tanks with blending tanks behind them. Cement storage and packing plant are in the background

Marquette Builds Mississippi's First Cement Plant

By BROR NORDBERG

MARQUETTE CEMENT MANUFACTURING CO.'S new portland cement plant near Jackson, Miss., is one of the industry's latest completely new operations, and is representative of the industry's decentralization to offset high transportation costs into areas with favorable growth potentials. It is the first portland cement plant to be built in the state of Mississippi and is the first entirely new mill built by Marquette since the company was founded 54 years ago.

Mississippi has been an object of attention by the portland cement industry for a number of years as a market area that warranted establishment of a cement plant, but the scarcity and nature of the available limestone deposits of suitable composition had discouraged earlier action. Marquette had engaged in prospecting and exploration over a period of years, in an endeavor to locate limestone deposits that would permit establishment of a mill that could ship a considerable distance in all directions before encountering more favorable transportation costs from competitive plants.

The site of the plant is outside the little city of Brandon, 12 miles east of Jackson, near the hub of rapidly developing lumber, cattle and agricultural areas. Jackson is a big cement-consuming center itself, as are the other larger cities, and the fact that the Mississippi river provides a means of cheap transportation for large construction projects along its course was a consideration. Electric power and natural gas are available at favorable rates.

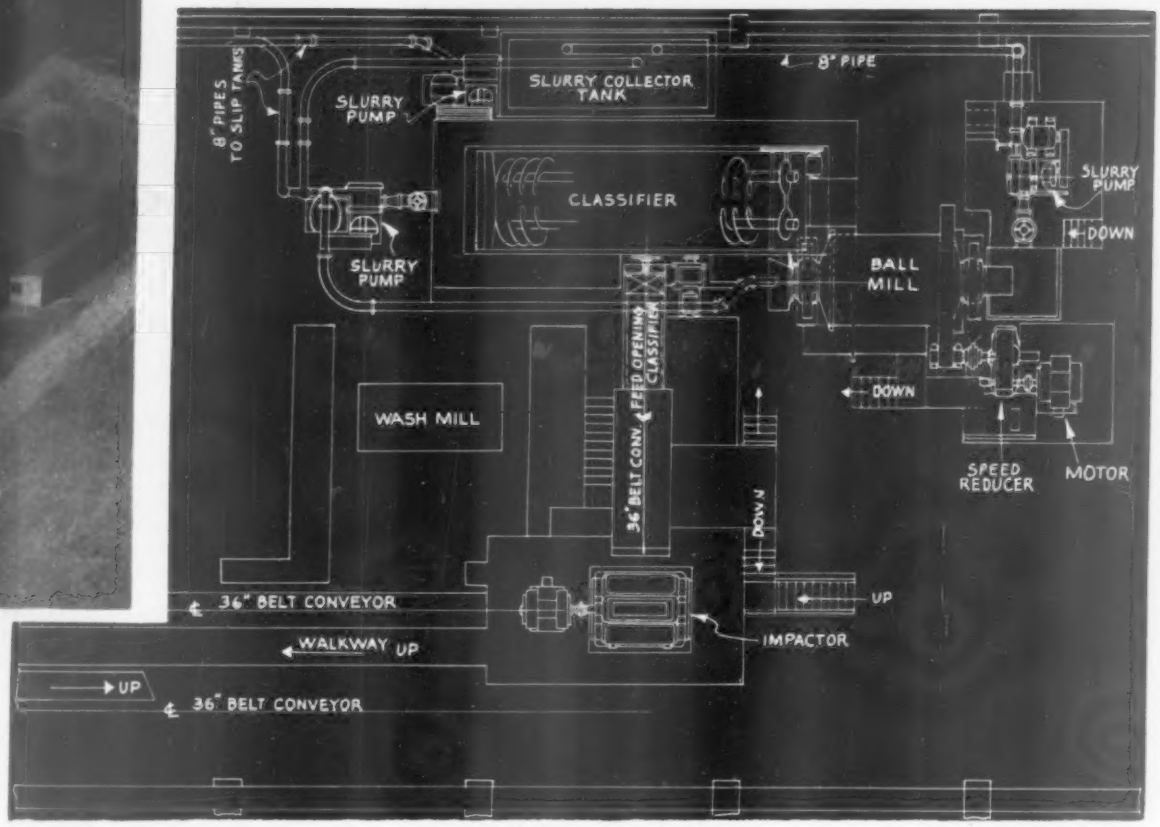
Production started late in 1951. The plant is wet process, with a 12- x 450-ft. rotary kiln, and has a rated annual capacity of 1,000,000 bbl. Its design has provided for later expansion of output which would include a second kiln and the doubling of equipment for both raw and finish grinding capacity.

Why Wet Process?

Nature of the raw materials required that the mill be wet process. The deposit contains limestone varying widely in hardness and composition, which is interbedded and intermixed with marl in various proportions. Of the total, the biggest quantity is marl, much of which occurs in the low micron sizes and which, even under dry weather conditions, holds approximately 26 percent water.

This deposit, because of its wide physical variations, presented extraordinary problems to be met in

Marly raw material required unique wash mill and highly developed blending methods. Marquette Cement Manufacturing Co. engineers apply latest technical advances throughout all operating departments



Floor plan of wash mill section of plant

processing, and later in blending and control, which have not been encountered at other cement plants. It required new and unique features in engineering design and equipment selection which resulted in a raw mill department, from the primary crusher right on through to the kiln feed tanks, that is the outstanding point of interest of the entire plant. Yet, the plant compares very favorably in its over-all economics with any built since World War II. It was built at a total cost of approximately $7 per barrel of annual capacity, which compares with $10-$12 for other new mills. Labor required in terms of man-hours per unit of production is one-third less than the average for the entire portland cement industry.

Layout

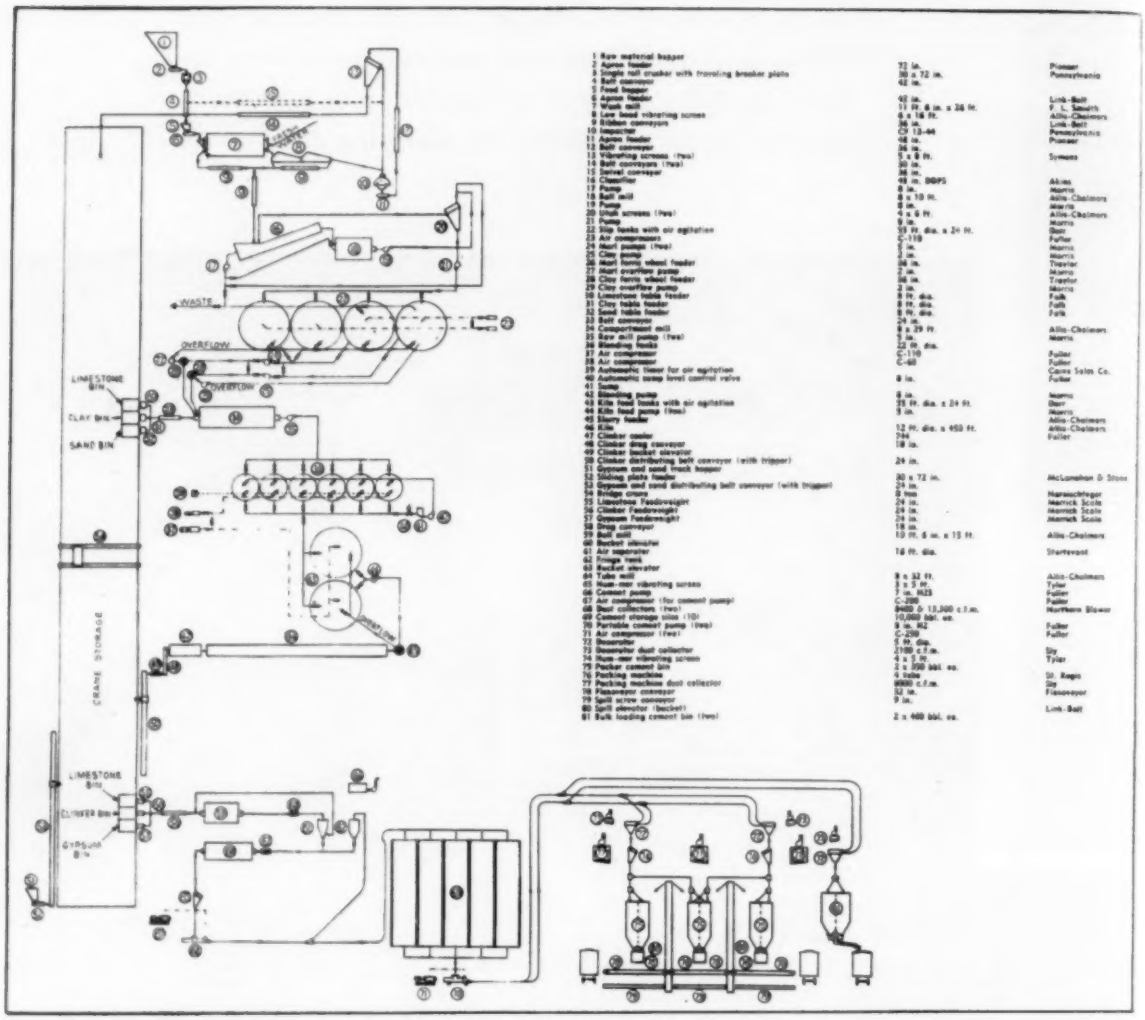
In contrast with other newer plants of L-design or modifications thereof, the single mill building which houses the wash mill and the raw and finish grinding equipment parallels the rotary kiln, with a long covered storage area between. An overhead bridge crane transfers raw materials from storage into overhead bins along the mill building wall from which the raw and finish mills are fed. A walkway tunnel was provided under the storage area, connecting the mill building with the kiln side of the plant where the blending tanks and kiln feed tanks are also located. Marl and clay slip tanks are located between the grinding mill building and the crushing plant, beyond which the quarry is located one-half mile distant.

Construction of the office and laboratory features the use of precast concrete units, and the mill building is of precast concrete and corrugated asbestos-cement siding with asbestos-cement louvres to provide ventilation. Roofs are of precast concrete slab construction. The soil is of compressible clay, and the buildings, with the exception of the blending tanks which are on piles, are supported on spread footings.

Mill capacities were designed for most effective power utilization. Finish grinding is done on the night power rate (for 16 hr. per day). Washing, quarrying and crushing operations require five 8-hr. shifts of operation per week and raw grinding is done around the clock. The plant, at present, produces Type I standard portland cement, Type II moderate heat of hardening cement, Type III high early strength portland cement, and masonry cement.

Operating Features

Aside from the wash mill and raw grinding departments, which are completely different from conventional cement mill practice, the plant has applied up-to-date developments and



General flowsheet and equipment for Brandon plant

principles in methods and technology throughout. Among the items of special interest are the following:

1. Rubber-tired diesel-powered quarry haulage units which are new to the cement industry.
2. Self-cleaning toothed roll crusher with traveling breaker plate.
3. Wash mill of special design.
4. Graphical proportioning and blending method for three-component mix, using four raw materials.
5. Instrumentation of kiln.
6. Unusually low stack dust loss and low raw materials requirement of 575 lb. per bbl. of clinker.
7. Flexible finish mill with four alternate grinding circuits.
8. Packhouse for high-speed packing and bulk loading, and foolproof against contamination.
9. Electrical interlocking circuits in processing.

Raw Materials

The source of limestone and marl is identified as the Vicksburg limestone, which is being quarried from a 600-acre deposit acquired by the company. It is covered by overburden which is the source of clay required for the raw mix. That processing, handling, proportioning and control are difficult is apparent from a description of the material.

About 80 percent of the total would be classified as marl and the balance is limestone of varying characteristics. Most of the material requires crushing. Material varies from a soft, crumbly and even mud-like unconsolidated limestone to consolidated material consisting of soft layers and some limestone of almost flint-like hardness. While the occurrence is in laminations, these are broken up through faulting into a mixture that varies throughout the deposit.

From 30 to 40 percent of the marly material is less than ten microns in size and much of it is smaller than one micron. By virtue of the large amount of colloidal material, holding anywhere from 20-34 percent moisture, the final slurry for kiln feed must necessarily be of higher than ordinary moisture content. This physical characteristic causes stiffening and necessitates a holding point of 45-48 percent water in the final slurry in order to maintain pumpability. Marl slurry by itself has a moisture content of 52 percent but dry limestone rock is proportioned with it to bring the figure down to 44-48 percent. Offsetting this disadvantage, the minus 10-micron fraction contributes to the formation of good, strong nodules in the preheating section of the kiln which makes for low dust losses in the exit gases and contributes to good burnability in the kiln.

Properties of the materials vary. Some material contains 74-75 percent calcium carbonate and, on the other hand, some is high in alumina. Generally, the limestone rock is higher in $CaCO_3$ than the marl.

A typical analysis of the limestone by weight as put in storage, after removal of marl and clay, is as follows:

Left: A 25-ft. face is drilled by track-mounted rotary drill. Right: View of quarry containing both marl and limestone, which must be excavated from above by diesel-powered dragline

Loss	—	41.82
SiO_2	—	1.68
Al_2O_3	—	3.41
Fe_2O_3	—	1.47
Lime	—	50.74
		99.12

Chemical analysis of the marl is such as to require two-stage proportioning for greater accuracy, first through preliminary proportioning as fed to the raw mill and then through accurate blending.

An average marl has an analysis like the following:

Loss	—	38.47
SiO_2	—	7.66
Al_2O_3	—	2.85
Fe_2O_3	—	1.75
Lime	—	47.02
		97.75

A low analysis marl, which would approximate the ideal for cement manufacture, has an analysis, typically, as follows:

Loss	—	34.75
SiO_2	—	14.64
Al_2O_3	—	3.48
Fe_2O_3	—	2.42
Lime	—	42.11
		97.40

Thus, the materials proportioned for cement manufacture are crushed limestone, a marl slip, clay supplied from the overburden either as a dry material during the summer or as a clay slip, and sand. Clay and sand are required in small quantity and present no problem. Limestone, however, cannot be produced without also producing large quantities of marl slip and the problem is to use the marl and limestone in their natural proportions, as quarried, to make economic use of the raw materials.

Quarrying

Drilling and blasting is required, and no attempt is made at selection in excavating for plant delivery. Approximately 350,000 cu. yd. of earth were removed by Caterpillar scrapers to open the quarry. A 25-ft. face is being worked and drilling is done with a diesel-powered Joy Middleweight Champion which sinks 3¼-in. vertical blast holes, the dynamite being decked into solid rock and detonated by Primacord. A wet sandy condition on the floor does not permit the use of a power shovel so excavation is done by dragline from above. A 1055 P&H diesel-powered dragline with a 3½-cu. yd. Page rock bucket, swung from an 80-ft. boom, loads directly into trucks.

Haulage to the crushing plant is done with four model TL-1015 Easton gooseneck-type trailers of 15-ton capacity each, hooked to Caterpillar DW-10 diesel tractors. The bodies are of the lift-door, side-dump type designed for fixed point dumping using the Easton electric overhead dumping system which consists of a push-button controlled overhead hoist. When actuated, the hoist operates a dual hook which engages two dumping bars on the lift door. The door is raised clear of the load and then serves to raise the body to the required discharge angle. As the unit is being dumped, the trailer frame is stabilized by stabilizer feet on each end which rest on the hopper wall.

Left: Bodies on the trailer trucks are of the lift-door, side-dump type, dumping being done by an electric overhead hoist activated by push button. Right: Diesel tractors with trailers haul 15-ton loads from the quarry to the primary crushing plant

Left: Drum-type wash mill where stone is washed and separated from fines. Right: Limestone from ½- to 10-in. size is put through reversible impactor shown here, which is close-circuited with vibrating screens. Minus ½-in. washed stone is conveyed directly into storage

Bodies and trailers are of welded steel construction, heavily reinforced, and the body floors have oak floor cushions and replaceable steel liner plates. The trailer has Bendix-Westinghouse air brakes and heavy-duty 20-ply tires.

All-weather roads of gravelly-clay construction were built and are maintained by a road-grader. The trucks, with their large traction-type tread tires, are proving effective in operating through slippery clay and gumbo at the face even during periods of heavy rainfall. They make about 35 round trips each in 8 hr. with a ½-mile one-way haul. Trucks of this size were selected in preference to larger units, for their speed and continuity of operation permits one to be drawn from service for needed repair.

Crushing

Material being a mixture of slabby stone of widely varying crushing resistance, soft lumps and wet, sticky material, a difficult problem was selection of a type of crusher that would be self-cleaning and not choke up with sticky materials and which would "tilt up" the big slabs that might otherwise ride in the crusher opening. A specially designed Pennsylvania single roll crusher, 30-in. dia. x 6 ft., was installed to turn at a fixed speed in relation to a traveling breaker plate. The roll has large teeth, or "nubs," arranged in rows around its periphery and the link design breaker plate is also studded with teeth which pass between those on the roll. It operates like a continuous vertical belt. Roll speed is 40 r.p.m. and the breaker plate speed is 31 f.p.m. Setting is 10-in. apart and the crusher was designed to produce 300 t.p.h. of minus 10-in. material. The drive is a 150-hp. slip-ring motor through gear reducer and has a reversing switch which may be used to dislodge hanging stone if that becomes necessary.

This crusher is not unlike some used by the gypsum industry, and has proved very effective in this application. Feed is regulated into the crusher by a 72-in. wide apron feeder from the overhead truck hopper and the product is carried over a 42-in. belt conveyor to the wash mill feed hopper inside the mill building.

Wash Mill

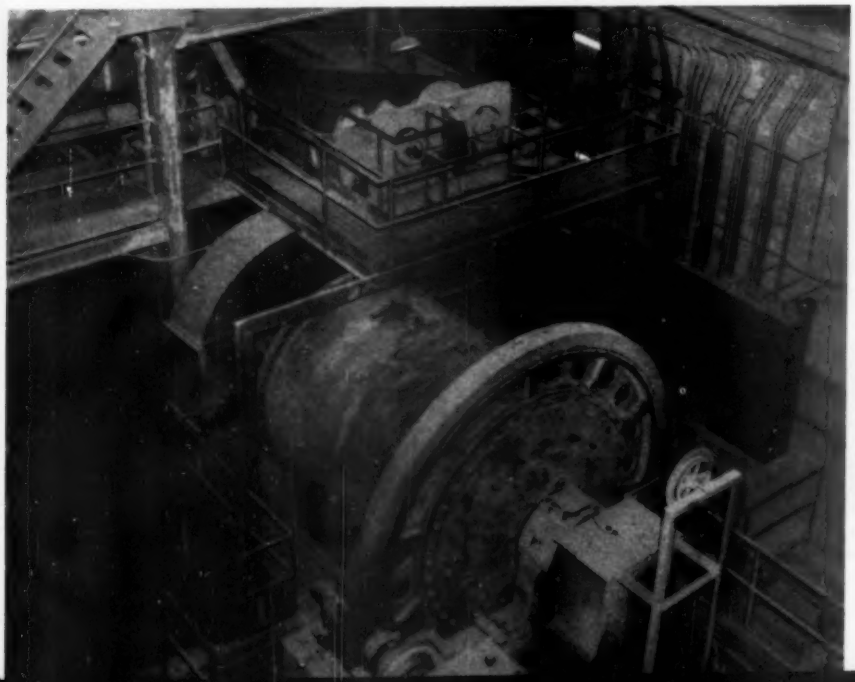
Preparation of slurry involves a special wash mill as the key to the process. A 42-in. apron feeder regulates the flow into a Smidth wash mill of special design. The wash mill has the outward appearance of a compartment mill and is mounted on the horizontal. It is 11 ft. 6 in. inside diameter x 26 ft. in length and is driven at 16.3 r.p.m. by a 600-hp. motor through a gear and pinion drive, flexible coupling and single-reduction speed reducer. It has a 1-in. shell except for 1¼ in. at the supports. The unit does not turn on bearings but slides on riding rings fitted into two stationary shoes that support the entire mill.

Material is fed into the wash mill at its axis and water is introduced at the opposite end—counter-current—to clean the stone and wash the soft fraction into a slurry. This slip passes through ½- x 4-in. slots in a screen band around the inlet spout, carrying with it hard particles up to ½-in. size, the stream being carried by 36-in. ribbon conveyors into a 48-in. twin screw Akins classifier.

The entire inside wall of the wash mill is lined with steel paddles or cascaders and the rock is propelled back and forth by the paddles until clean rock is discharged through the outlet end and put over a 6- x 16-ft., two-deck vibrating screen. Thus, a separation at roughly ½ in. is made through the wash mill, a slip has been made of the fine fraction and clean rock is discharged for further reduction later. Most of the water is added to the wash mill, at a rate of 300-600 g.p.m.

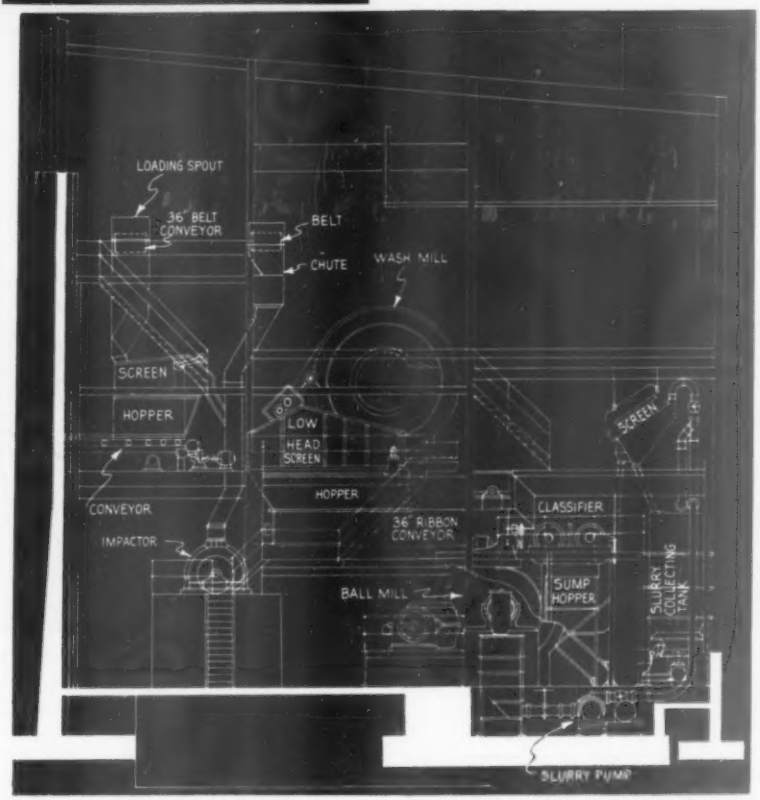
The 6- x 16-ft. vibrating screen carries ½-in. square mesh on the

In wash mill department, minus ½-in. material from drum-type wash mill is put through twin screw classifier (top of picture). The product coming over the drainboard of the classifier is put through the 8- x 10-ft. ball mill below, and then put over two slurry screens. Overflow from the classifier is also pumped over the screens, throughs being pumped into the slip tanks. Plus 16-mesh material returns into the classifier



Left: Two interior views of wash mill. At left is shown the inlet end, feed entering through the feed spout in the center and the slurry containing particles up to ½-in. size passes through the screen band to be put through a twin-screw classifier. The steel paddles lining the mill move larger material to the outlet end shown at right countercurrent to the water stream

Below: Cross section through wash mill



bottom deck with larger mesh on the top to resist the shock from the bigger stone. A 36-in. ribbon conveyor delivers the throughs into the aforementioned classifier and the oversize —up to 10-in.—is put through a Pennsylvania reversible impactor for reduction to minus ½ in. The impactor is closed-circuited with two 5- x 8-ft. horizontal vibrating screens operating in parallel. A 48-in. apron feeder delivers the crusher product to a 36-in. belt conveyor which divides the stream over the overhead screens. Oversize is returned to the impactor and minus ½-in. washed stone is carried directly into the covered storage area by two horizontal 30-in. belt conveyors. The impactor is driven by a direct-connected 300-hp. slip ring motor at 900 r.p.m.

Clay is processed separately into a slip by the same process as described for marl except that during the summer months, when it is dry, it may be processed dry. A by-pass 30-in. swivel belt conveyor has been provided for the purpose, ahead of the wash mill, taking the flow of clay from the 42-in. primary conveyor coming from the crushing plant and diverting it directly to the impactor. Thus, dry clay may be sized and placed into covered storage.

Having dry materials, particularly washed limestone, is important to the economics since the marl slip is high in moisture, 52 percent being required in the wash mill for proper lubrication, and it is desired to interblend dry material later in the process to reduce water content. As it is, the final slurry carries up to 48 percent water as fed into the kiln.

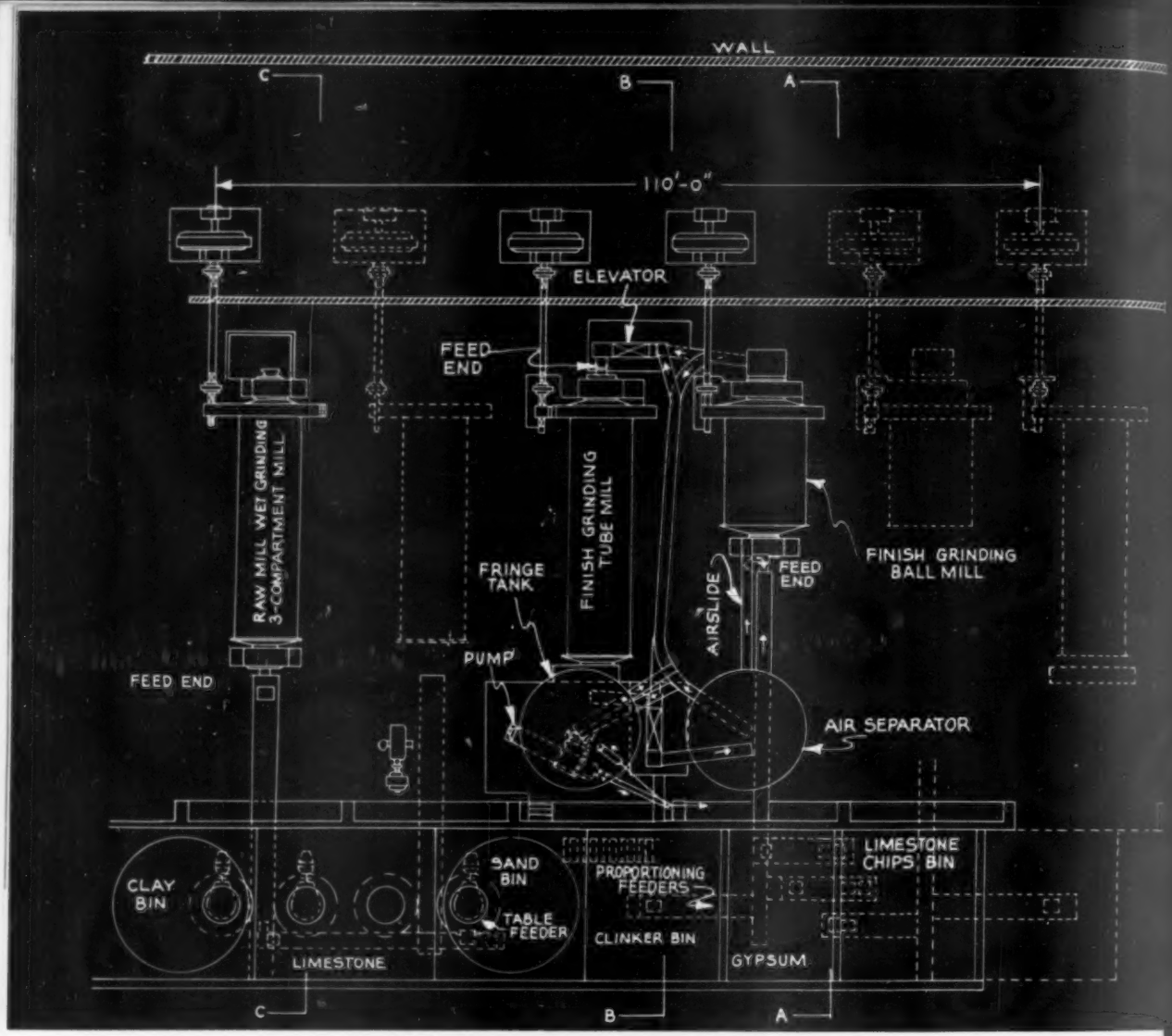
Returning to a consideration of the fines, as fed into the classifier, the slimes overflowing the weir are pumped by an 8-in. slurry pump and put over two 4- x 6-ft. Utah electric vibrating screens carrying No. 16 wire screen cloth. Material coming off the drainboard of the classifier is put through an 8- x 10-ft. Allis-Chalmers ball mill and the product from the mill is put over the same screens by an 8-in. slurry pump. Material through the screen cloth drops into a slurry collecting tank from which an 8-in. slurry pump delivers into any of the four outside slip tanks. Oversize is returned into the classifier. At times, part of the slimes overflowing the classifier may be pumped to the ball mill for make-up water or the slimes could by-pass the electric vibrating screens into the slip tanks. The ball mill is driven at 21.5 r.p.m. by a 300-hp. synchronous motor and single reduction speed reducer. All the slurry pumps are of Morris manufacture and the drives are 100-hp. and 75-hp. motors through V-belt.

Slip Tanks

The four slip tanks, measuring 55 ft. in diameter x 24 ft., have Dorr mechanical and pneumatic agitation and each has a capacity of 4125 bbl. in terms of clinker. Two C-110 Fuller rotary air compressors supply the air for agitation in the tanks. Generally, marl slip is held in three tanks, and clay slurry in the fourth. Together, the tanks provide a reserve for four days of operation.

Raw Mill

Preliminary proportioning and mixing is done in feeding various combinations of materials into an 8- x 29-ft. Allis-Chalmers three-compartment mill. No attempt is made to grind kiln feed materials due to the many variables inherent in the materials and proportioning devices. Instead, practice is to combine the four materials into three different types of slurries. Marl slip and dry limestone are combined to yield a "high lime" slurry, marl slip and clay to give a "low lime" slurry, and marl slip and sand to yield a "high silica" slurry. It is from analyses of these separate



Floor plan showing general arrangement of raw and finish grinding mills

slurries that more accurate blending is accomplished.

The four separate materials so combined and interground in the mill are marl slip, either clay slip or dry clay in the summer months, limestone and silica sand. The dry materials are held in covered storage paralleling the mill building from which each is handled into a separate overhead feed tank adjoining the mill building wall by bridge crane. These feed tanks are arranged in a line adjacent to the grinding equipment to be fed. Dry limestone, dry clay when used, and sand are fed in desired proportions from their respective bins, each by an 8-ft. dia. Falk table feeder, with cross belts, onto an inclined 24-in. belt conveyor which discharges into the compartment mill. Drives on the feeders are 7½/10 hp. d-c motors rated at 400/1200 r.p.m.

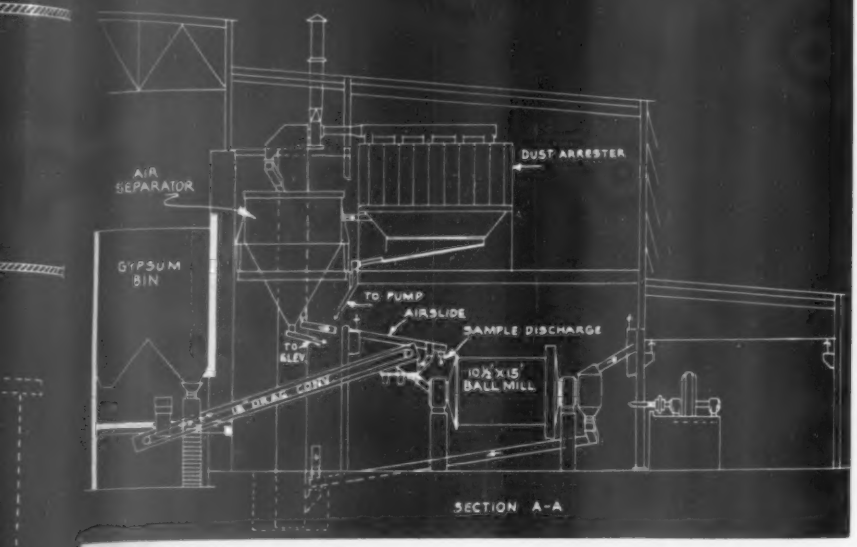
Marl slip is pumped by a 5-in. slurry pump from the marl slip tank into a head tank supplying a 36-in. Traylor ferris wheel feeder which regulates rate of feed into the compartment mill. Overflow is into a sump from which it is pumped by a 2-in. pump back into the slip tank. Similarly, clay slip is separately handled (2-in. pumps). Each slurry feeder has a 1½/2 hp. d-c drive. The mill is driven at 18.7 r.p.m. by a 700-hp. synchronous motor and the product is ground to a fineness of 78 percent passing a 200-mesh sieve. Output is 240 bbl. per hr. which is pumped to the blending tanks by two 5-in. Morris pumps.

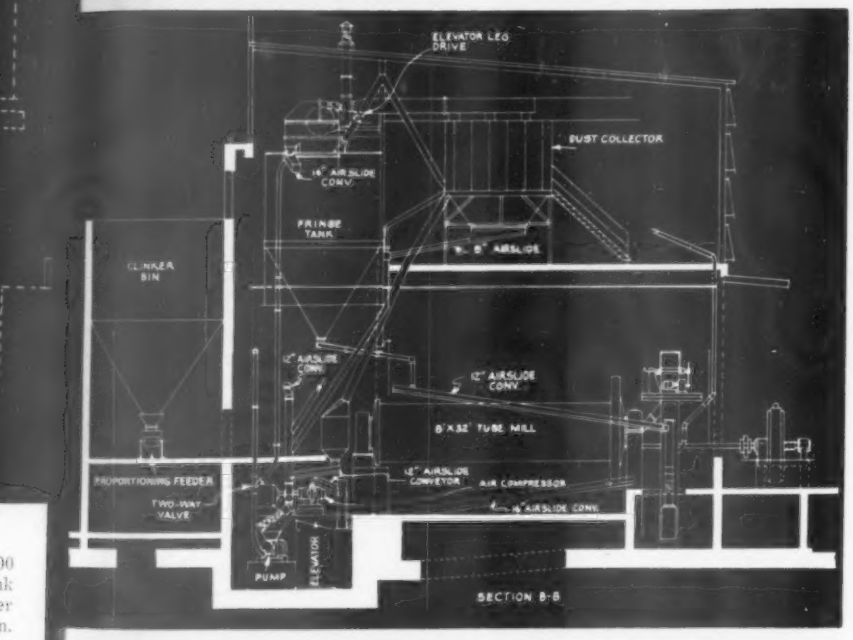
Blending

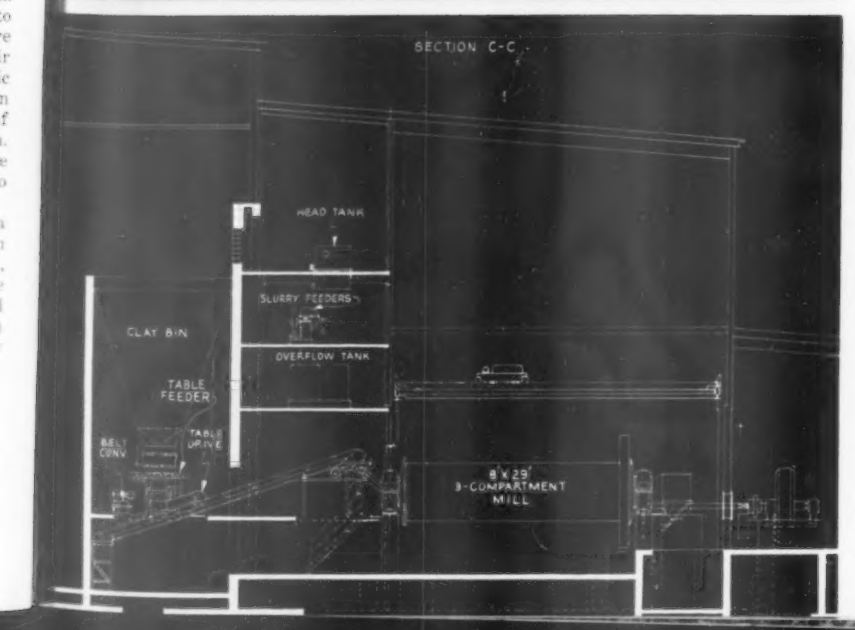
With the many variables existing in the raw materials, blending for control of kiln feed composition was emphasized in plant design, and an arrangement of blending tanks was installed to permit great flexibility. There are six 22-ft. dia. tanks, 40 ft. high, arranged in a row from which kiln feed material is delivered, after blending by an 8-in. slurry pump, into two 55-ft. dia., 24-ft. high Dorr kiln feed tanks with air agitation.

Each blending tank has capacity sufficient for one 8-hr. shift or 1200 bbl. of clinker and each kiln feed tank has capacity for 3600 bbl. of clinker or one full day's kiln operation. Separate slurries are delivered into the appropriate blending tanks where they are subjected to intermittent air agitation controlled by an automatic timer. Each tank is subjected, in sequence, to a total of ten minutes of air bubble agitation per hr. An 8-in. automatic sump level control valve regulates flowout from any tank to the 8-in. slurry pump.

Corrected slurry is delivered by a 5-in. slurry pump from either kiln feed tank to the kiln slurry feeder, with the overflow returning into the tank. Slurry is completely blended and mixed when placed in the kiln feed tanks, practice being to draw from one while filling the second. Slurry in the blending tanks is sampled at 2-hr. intervals and, blending being done on a volume basis, a calibrated chain system was devised for quick measurement of slurry drawn per inch of tank height.







Kiln feed is sampled daily for moisture and volume, and a complete kiln feed analysis is run daily. Determinations of fineness and moisture content of the raw mill product are made at 2-hr. intervals. Electric contacts were provided throughout in the slurry tanks and in pump sumps to sound warnings and flash lights for the guidance of the operator. An electrode in the sump for raw material out of the compartment mill will stop the mill at a fixed level in the sump.

Graphical Blending

A quick method for mix control has been devised, involving use of a control chart and an ordinary engineer's scale in the solution of a blending problem. This measurement chart is simple to use, since complex chemical relations are not involved in its operation, and men without any special training are capable of solving a blending problem in three minutes by its use.

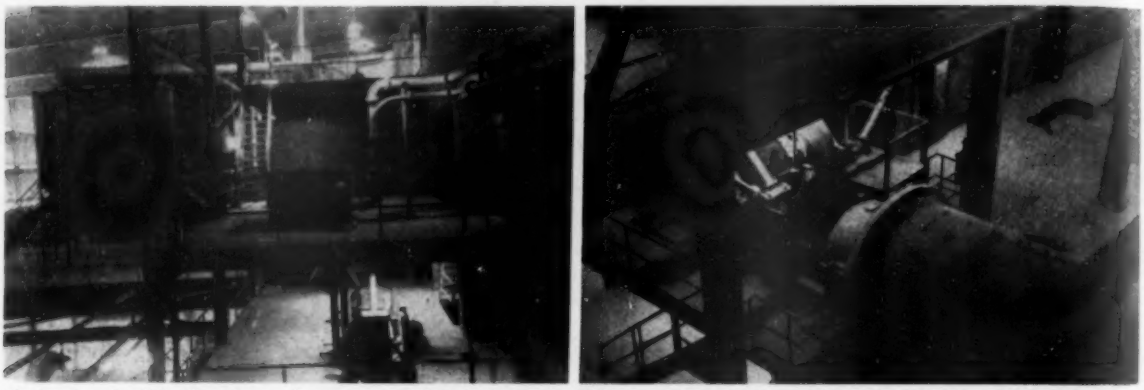
Because the marl has a tendency to be very easy-burning, it was decided to control not only the C_3S but also the silica ratio of the mix. Silica ratio, obtained by dividing the percentage of SiO_2 by the percentage of R_2O_3, has a marked effect on the burning characteristics.

To control both of these qualities of the mix without the need for cumbersome technical calculations, it was decided to adopt the graphical method for proportioning slurries discussed by L. A. Dahl in P.C.A. Bulletin 17 to the conditions at hand. In order to apply the method for silica ratio (Dahl plotted C_3S vs. C_3A), silica ratio was transformed into a mathematical quantity called Q, this figure being the holding point for silica ratio x (R_2O_3)—SiO_2, and one that may be proportioned by graphical method.

To illustrate application of the method, shown here are analyses of three of the regular slurries (high lime, low lime and high silica). The ignited analysis is computed from the conventional unignited analysis, as shown, and the potential C_3S and "Q" of the slurry in each tank is on that basis.

Using these figures, the three tanks are plotted on the control chart as reproduced here for the purpose of illustration. In this case, the desired kiln feed is 55 percent potential C_3S and 2.90 silica ratio, which is plotted at 55 C_3S and zero Q. The three tanks are plotted and a line drawn from the high silica tank (No. 6 here) through the kiln feed point is extended downward. This is termed the silica line. Any tank plotting to the right of this line and below kiln feed is termed a high lime tank. Tanks to the left of the silica line and below kiln feed are low lime tanks, and any tank above kiln feed is high silica.

Top: Section of mill building showing ball mill for finish grinding. Center: Section showing tube mill in finish grinding circuit. Bottom: Section of raw grinding circuit



Left: Interior of mill building. Dust collectors are to left in background and fringe tank is shown on right. In foreground may be seen constant head tank and feeder for raw mill. Right: Feed end of raw grinding mill. Dry materials are fed by belt on left, simultaneously with slurry from feeders above

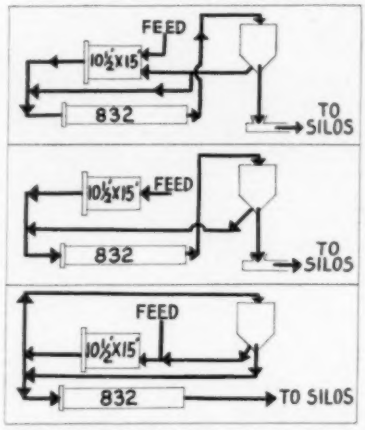
Chemical control of raw grinding is just accurate enough so that the tank being ground will fall in the desired one of these three categories.

Four measurements are made on the large full-scale chart in use. As shown for this particular blending problem, the distance from tank 6 to kiln feed was 6.95 in. From kiln feed to the intersection identified as mixture A was 2.62 in., etc. The measurements mean that 1.55 parts of tank 1 plus 2.70 parts of tank 4 will give mixture A (as explained in P.C.A. Bulletin 17), which is exactly on the silica line. And, 6.95 parts of mixture A plus 2.62 parts of tank 6 will give the desired kiln feed. All the proportions are on the ignited basis.

To be practical for slurry blending, these proportions are transformed into the relative volumes as slurry. This is accomplished by combining the three variables—moisture, specific gravity and ignition loss—into a single "Slurry Evaluation Factor" (SEF).

$$\text{SEF} = (\text{sp. gr.}) \times \frac{100}{100\text{-loss}} \times \frac{100}{100\text{-moisture}}$$

When the parts required on an ignited basis are divided by the SEF of the slurry, the relative volumes of slurry required in the blend are obtained. The relative volumes of each slurry are expanded proportionately so that, in blending kiln feed, at least one of the three tanks involved may be emptied to provide room for fresh slurry. A form also shown here is the means of checking on the calculations and blending orders issued. The four measurements made from the control chart are checked as shown.

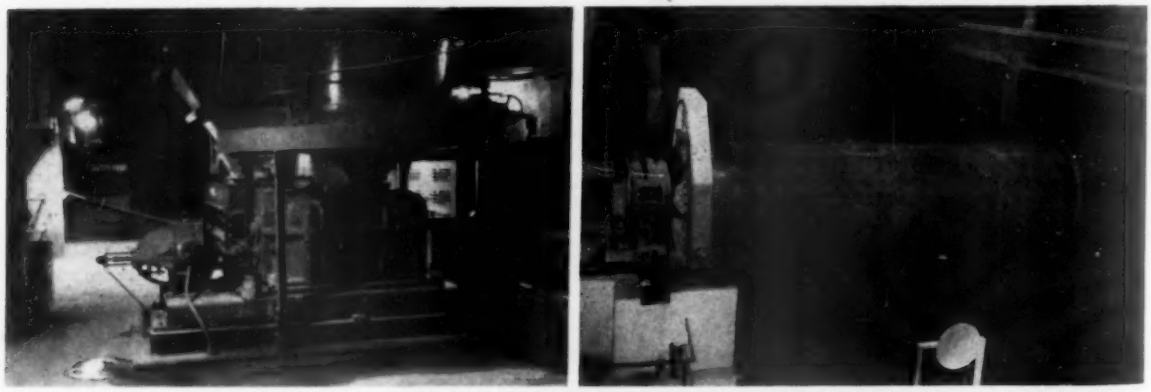


Three alternate finish grinding circuits. Circuit shown at bottom is now in use. A fourth possibility is consecutive grinding through the two mills in open circuit

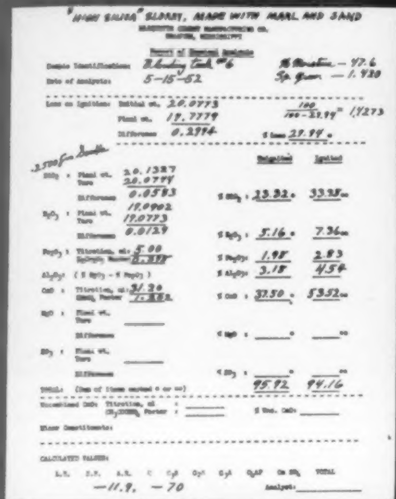
Kiln

Clinker is burned in a 12- x 450-ft. Allis-Chalmers rotary kiln, fed by an A-C ferris wheel feeder synchronized with the kiln speed, and is discharged over a No. 744 Fuller inclined grate clinker cooler with integral clinker breaker. The kiln is pitched $\frac{1}{16}$-in. to the foot and is driven by a dual drive consisting of two 125-hp. motors and spur gear reducers which makes for a smooth-running, vibration-free operation. Normal kiln speed is 60 r.p.h. The ferris wheel feeder has an A-C Vari-Pitch speed reducer.

The kiln is lined for its entire length, of which approximately 170 ft. is of 9-in. rather than 6-in. brick, for its greater insulation value. Eighteen feet from the front end is of 70 percent alumina brick followed by 40 ft. of basic brick in the hot zone. Basic brick is preferred for hot zone service based on long-time experience in the 475-ft. kiln operated at the company's Des Moines, Iowa, mill. However, a



Left: In raw mill, dry limestone and dry clay (when used) are proportioned by table feeders, the blend being delivered by inclined belt conveyor into compartment mill. Marl slip, and sometimes clay slip, are delivered into mill also in desired proportions. Right: Raw mill is in foreground. Behind it is tube mill for finish grinding of cement, with preliminary clinker ball mill beyond. Synchronous motors for all three mills are in the main power station adjoining, which is under slight pressure to keep out dust



"HIGH SILICA" SLURRY, MADE WITH MARL AND SAND

Report of Chemical Analysis

Sample Identification: Blending Tank #6 — % Moisture – 47.6; Sp. grav. – 1.420

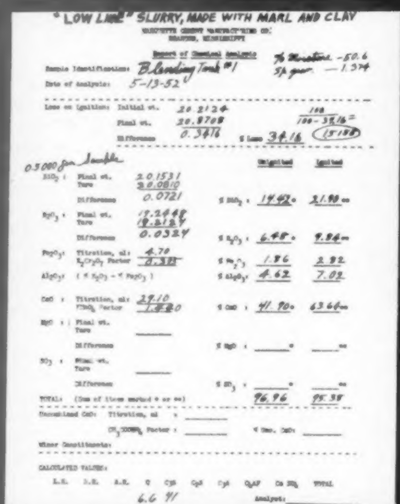
Date of Analysis: 5-15-52

Loss on Ignition: Initial wt. 20.0773; Final wt. 19.7779; Difference 0.2994; 100/(100–29.94) = 1.4273; % Loss 29.94

.2500 gm Sample

		Unignited	Ignited
SiO_2	Final wt. 20.1327; Tare 20.0744; Difference 0.0583	23.32	33.28
R_2O_3	Final wt. 19.0902; Tare 19.0773; Difference 0.0129	5.16	7.36
Fe_2O_3	Titration, ml: 5.00	1.98	2.83
Al_2O_3	(% R_2O_3 – % Fe_2O_3)	3.18	4.54
CaO	Titration, ml: 31.20	37.50	53.52
MgO			
SO_3			
TOTAL	(Sum of items marked * or **)	95.92	94.16

CALCULATED VALUES: –11.9, –70



"LOW LIME" SLURRY, MADE WITH MARL AND CLAY

Report of Chemical Analysis

Sample Identification: Blending Tank #1 — % Moisture – 50.6; Sp. grav. – 1.374

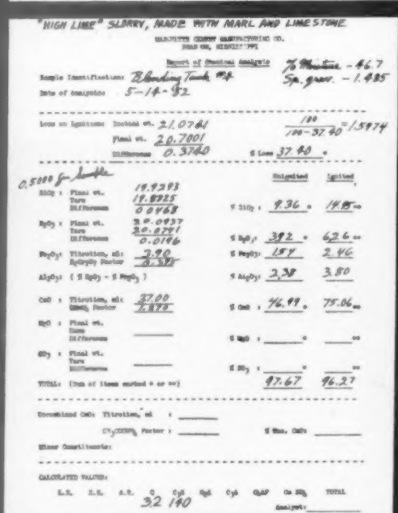
Date of Analysis: 5-13-52

Loss on Ignition: Initial wt. 20.2124; Final wt. 19.8708; Difference 0.3416; % Loss 34.16; 100/(100–34.16) = (1.5188)

0.3000 gm Sample

		Unignited	Ignited
SiO_2	Final wt. 20.1531; Tare 20.0810; Difference 0.0721	14.42	21.90
R_2O_3	Final wt. 19.2448; Tare 19.2124; Difference 0.0324	6.48	9.84
Fe_2O_3	Titration, ml: 4.70	1.86	2.82
Al_2O_3	(% R_2O_3 – % Fe_2O_3)	4.62	7.02
CaO	Titration, ml: 29.10	41.90	63.66
MgO			
SO_3			
TOTAL	(Sum of items marked * or **)	96.96	95.38

CALCULATED VALUES: 6.6, 41



"HIGH LIME" SLURRY, MADE WITH MARL AND LIMESTONE

Report of Chemical Analysis

Sample Identification: Blending Tank #4 — % Moisture – 46.7; Sp. grav. – 1.485

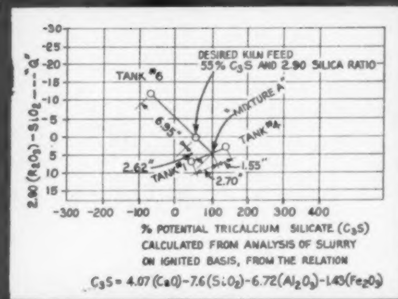
Date of Analysis: 5-14-52

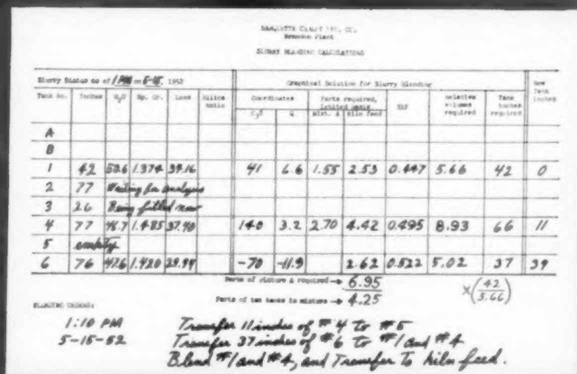
Loss on Ignition: Initial wt. 21.0781; Final wt. 20.7001; Difference 0.3780; % Loss 37.40; 100/(100–37.40) = 1.5974

0.5000 gm Sample

		Unignited	Ignited
SiO_2	Final wt. 19.9393; Tare 19.8925; Difference 0.0468	9.36	14.95
R_2O_3	Final wt. 20.0937; Tare 20.0741; Difference 0.0196	3.92	6.26
Fe_2O_3	Titration, ml: 2.90	1.54	2.46
Al_2O_3	(% R_2O_3 – % Fe_2O_3)	2.38	3.80
CaO	Titration, ml: 37.00	46.99	75.06
MgO			
SO_3			
TOTAL	(Sum of items marked * or **)	97.67	96.27

CALCULATED VALUES: 32, 140





SLURRY BLENDING CALCULATIONS

Slurry Status as of 1 PM on 5-15, 1952 — Graphical Solution for Slurry Blending

Tank No.	Inches	H_2O	Sp. Gr.	Loss	Silica Ratio	Coordinates C_3S	Coordinates Q	Parts required, ignited basis: Mixt. A	Parts required, ignited basis: Kiln feed		Relative volumes required	Tank inches required	New Tank Inches
A													
B													
1	42	50.6	1.374	34.16		41	6.6	1.55	2.53	0.447	5.66	42	0
2	77	Waiting for analysis											
3	26	Being filled now											
4	77	46.7	1.485	37.40		140	3.2	2.70	4.42	0.495	8.93	66	11
5	empty												
6	76	47.6	1.420	29.94		–70	–11.9		2.62	0.522	5.02	37	39

Parts of mixture A required → 6.95

Parts of two tanks in mixture → 4.25

× (42 / 5.66)

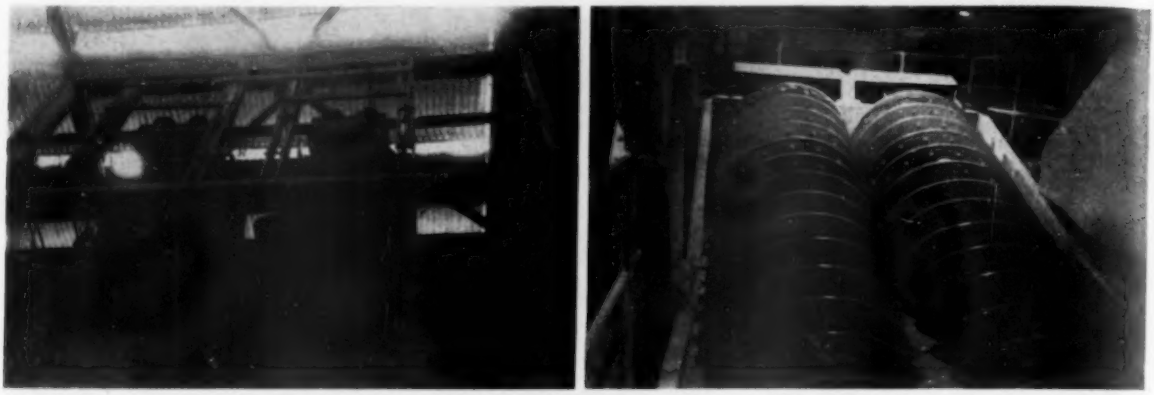
BLENDING ORDERS:

1:10 PM 5-15-52

Transfer 11 inches of #4 to #5
Transfer 37 inches of #6 to #1 and #4
Blend #1 and #4, and Transfer to kiln feed.

Shown here is an example typical of the graphical method for blending raw materials consisting of crushed limestone, marl slip, clay and sand. It is based on control of the C_3S and the silica ratio as described for this particular blending problem. The four materials are combined two at a time into three slurries, "high silica," "low lime" and "high lime." On the left are analyses of three such slurries from which the three tanks are plotted on the control chart shown at top right. Actual size of this chart is 24 x 32 in. In this case, the desired kiln feed is 55 percent potential C_3S and 2.90 silica ratio. Above is shown the form used to serve as a permanent record of the calculations and blending orders issued. Details of solution of this blending problem are described under the heading "Graphical Blending" in this article

Covered storage area is between kiln and mill building (left). Note bins on left wall from which grinding mills draw feed



Left: Slurry is screened over No. 16-mesh cloth on these electric vibrating screens, the throughs being pumped into slip tanks and oversize returned to twin screw classifier. Right: Slip from wash mill enters this classifier for size separation. Overflow fines are pumped to slurry screens and the sands are fed to a ball mill

high alumina brick is more serviceable at the front end for its greater resistance to abrasion. Back of the basic brick there is 38 ft. of 70 percent alumina brick followed by 75 ft. of 40 percent alumina brick. From this point the brick are 6 in., consisting of 40 percent alumina to the chain section and ordinary abrasion-resisting brick through the chains to the back end of the kiln.

The chain section, by Smidth, is approximately 100 ft. in length, consisting of 15,000 lineal ft. of ⅝-in. chain suspended in a dense spiral pattern without overhang.

Firing is by natural gas of 1000 B.t.u. heat value per cu. ft., through an air-cooled burner pipe with a protective tube of heat-resisting alloy steel. Preheated secondary air for combustion is supplied from the clinker cooler bed, through which air is forced at the rate of 68,000 c.f.m. of air total by a Bayley Aeroplex fan driven at 740 r.p.m. through V-belt by a 100-hp. motor. The grate is driven through a Reeves vari-speed motor and a 10-hp. motor which is the means of automatic grate speed adjustment to maintain the desired secondary air temperature. Excess cooling air through the clinker bed is exhausted through a stack after passage through a Western Precipitation Multiclone dust collector which has a Bayley Aeroplex blower driven through V-belt by a 125-hp. motor. Dust trapped in the collector is discharged through a Western Precipitation automatic-tipping dust valve and spout on to the drag conveyor carrying the clinker to storage. This drag discharges into the boot of a bucket elevator from which a 24-in. belt conveyor with tripper delivers the clinker into storage.

Draft is supplied by a 176,000 c.f.m. (4 in. w.g.) fan and the exit gases are exhausted through an ordinary dust chamber, through the fan and into the stack. About one truck-load of dust per week is the total amount of dust recovered in the dust chamber and there is very little evidence of dust coming out the stack, the exhaust having the appearance of a thin gaseous plume. The fact that only 575 lb. of raw material is required per bbl. of clinker substantiates that dust loss from the kiln is very low.

Instrumentation

Instrumentation is complete, covering all the kiln and directly related operations and is centralized on a single Allis-Chalmers control panel. There are 45 instruments on this panel. Gas analysis is considered of utmost importance to firing control, and a Cambridge gas analyzer records the percentage of O_2, of CO_2 and of CO and combined combustibles as an accurate check on firing conditions and changes occurring in the kiln. The analyzer has a porous stainless steel filter at the feed pipe. To minimize fouling, the filter is blown out twice per shift, and condensed water from the sampling pipe is drained at 2-hr. intervals.

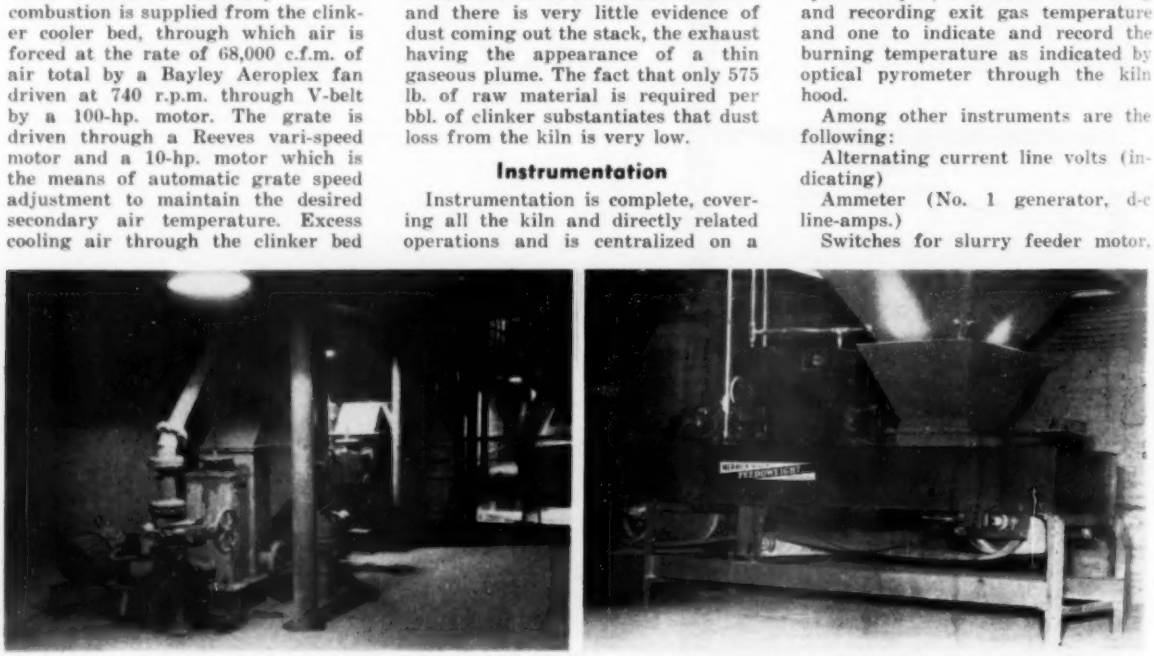
Among the other key control instruments are a Hays draft indicator and recorder for both hood draft and back end draft, a Micromax (L. & N.) for indicating and recording kiln speed in r.p.h., a Micromax indicating and recording exit gas temperature and one to indicate and record the burning temperature as indicated by optical pyrometer through the kiln hood.

Among other instruments are the following:

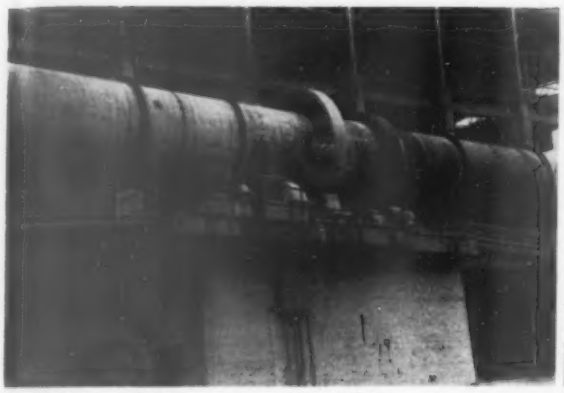
Alternating current line volts (indicating)

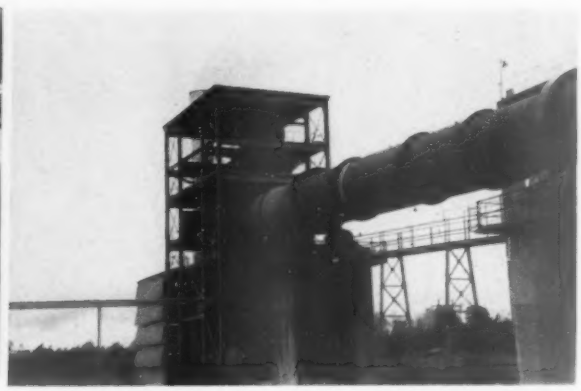
Ammeter (No. 1 generator, d-c line-amps.)

Switches for slurry feeder motor,



Left: Feeder units for clay slip and marl slip, which regulate proportions into raw mill below. Right: Separate interlocked feeders like this one proportion clinker and gypsum for feed into the preliminary ball mill over an 18-in. drag conveyor





Left: Kiln has dual drive consisting of two 125-hp. motors and spur gear reducers. Right: Back end of kiln showing dust chamber and induced draft fan below

motor-generator sets (2), kiln motors
Totalizer (total hours operated)
Voltmeter for kiln motors
Switch for exhaust fan damper motor
Indicator for exhaust fan damper position
Clock
Alarm horn stop
Gas pressure indicator
Gas pressure recorder
Ammeter for cooler fan motor
Ammeter for dust collector motor
Red light which flashes for high exit gas temperature
Ammeter for exhaust fan motor
Indicator for gas flow
Recorder for gas flow
Telephone connecting front and back ends of kiln

Starters for clinker elevator, clinker belt conveyor, clinker drag conveyor, clinker breaker motor, spill screw conveyors, cooler drive motor, cooler fan motor, dust collector motor and exhaust fan motor.

Kiln Operation

Marquette was one of the first manufacturers of portland cement to operate a kiln in excess of 400 ft. and, as a result of many years of experience with a 475-ft. kiln at Des Moines, Iowa, has patterned firing practices at Brandon along the lines proved at that plant.

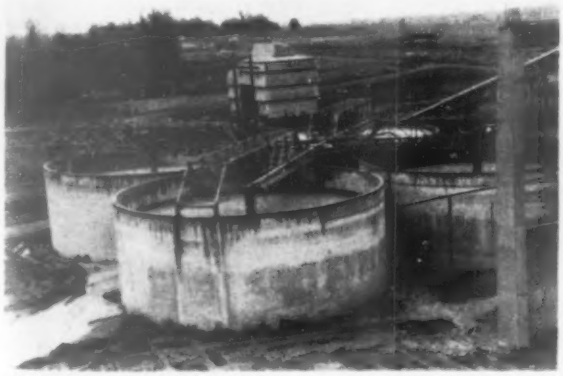
Its successful experience with basic hot zone lining and the use of 9-in. brick rather than 6 in. as a substitute for insulation were adapted to the Brandon kiln.

Firing practice is based on establishing the desired back end temperature and holding the kiln speed constant, factors which are the measure of fuel efficiency. At Brandon, the exit temperature is held at about 520 deg. F. and the kiln speed at 60 r.p.h. Changes in the kiln speed are made only when absolutely necessary, preference being to change the gas rate to meet ordinary variations in the kiln. Having established the holding point for exit gas temperature and stabilized the kiln speed, it then becomes the responsibility of the burner to do what is necessary in firing and to anticipate changes in advance and prepare for them so as to prevent cycling inaccuracies.

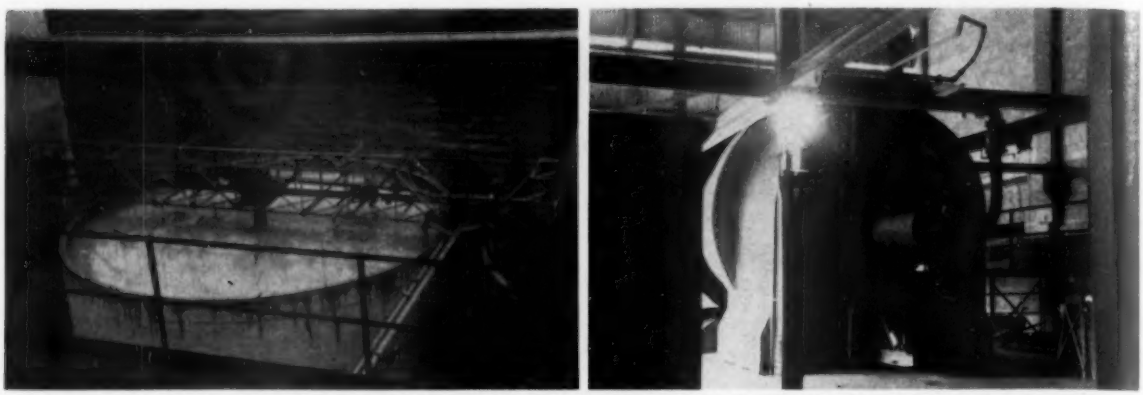
Instruments are considered important but not for their automatic features. They serve as indicators of changes in the kiln and in firing, thus enabling the burner to anticipate troubles. They also have proved to give the burners confidence. There are only two automatic features in connection with the Brandon kiln. Rate of feed into the kiln is through synchronous tie with the kiln speed, and secondary air temperature is automatically controlled through automatic bed speed control on the cooler grate. As the bed of clinker thins out on the cooler grate, more volume of air comes through at lower temperature into the kiln, when the bed speed is slowed to build up the bed thickness. The grate, of course, speeds up when the reverse is true.

Practice is to hold the O_2 in the exit gases at approximately 1½ percent and not to exceed 2 percent, and to hold a CO_2 reading up to 18-20 percent as a control against too much air or gas. A low O_2 reading is an aid to holding the coating on the brick and is desired to conserve fuel and to hold a high level of heat in the kiln. Too high an O_2 percentage has, by past experience, resulted in loss of lining, wasted fuel and cooling off of the kiln. The CO_2 reading is an indicator of kiln ring buildup, dislodgment of rings and other variations in uniform operation. If a ring is forming the reading goes up, which permits the burner to fire up proportionately before the flow of materials reaches the burning zone.

A long burning zone with the flame



Left: Four slip tanks from which slip is drawn for preliminary blending through raw mill. Right: One of four slip tanks. Each has a capacity of 4125 bbl. in terms of clinker and has both mechanical and air agitation



Left: One of two kiln feed tanks. Each has capacity for one full day's kiln operation. Right: The kiln is fired by natural gas through an air-cooled burner pipe

directed right down the middle of the kiln is preferred for uniformity and to minimize turbulence. Rear end draft is held at 2 in. w.g.

Performance of the kiln apparently is excellent. Fuel consumption is approximately 1,400,000 B.t.u. per bbl. which might be considered high for a 12- x 450-ft. kiln but the kiln feed necessarily contains up to 48 percent moisture.

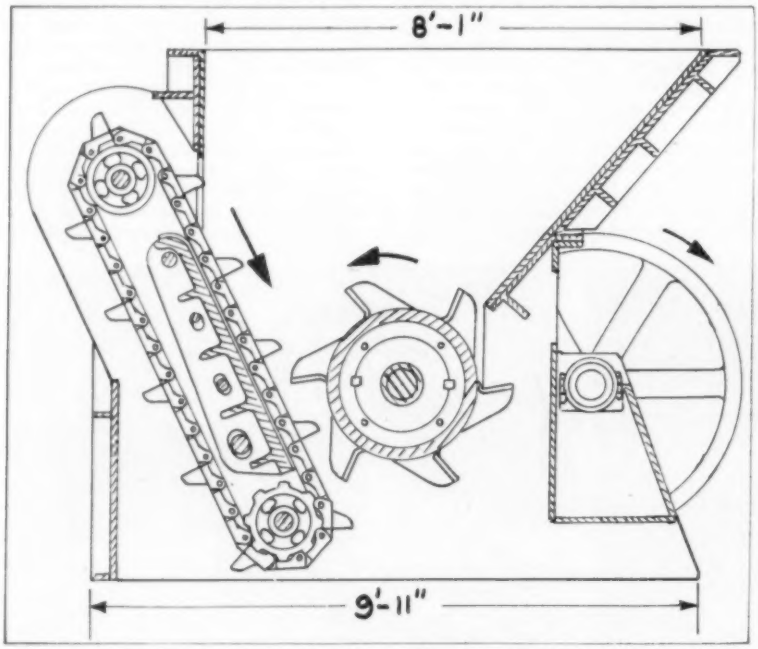
On the other hand, the mix has good burnability due to the micron sizes in the marl and forms very sound nodules in the kiln which reflect in low dust loss and small-sized perfect individual clinkers that have lots of glass and which are very sound. Samples taken from ports through the kiln shell just inside the chain section and also just coming out of the chain section, for the purpose of consistency determinations, indicate that 18-20 percent moisture in nodules coming out of the chain section gives best results. This moisture is higher than the average for most long, wet process kilns, because the moisture in the feed is higher than average, but apparently helps to make the chain section effective in taking up dust from the gases.

Total alkalies in the finished product average about 0.25, which is low, and autoclave tests for soundness likewise are extremely favorable.

Material Storage

The covered storage area, paralleling the kiln the entire length of the mill building, which houses both raw and finished grinding departments, measures 100 ft. across. Storage is in bays measuring 22 ft. wide x 100 ft. across and 22 ft. high. Seven of the bays are set aside for limestone and nine for clinker, storage capacity for clinker being some 100,000 bbl.

Across the mill side of the storage area are one-bay width draw-off tanks from which materials are drawn for grinding. Limestone, dry clay and sand tanks are opposite the raw mill grinding equipment, and the tanks for clinker, gypsum and limestone are similarly located opposite the finish mill equipment. Gypsum and silica sand are brought in by rail and fed from a track hopper by a 30-in. sliding plate feeder to a 24-in. distributing belt conveyor with tripper which discharges into the selected storage area. An 8-ton Harnischfeger bridge crane with No. 7300 Blaw-Knox bucket handles material in storage and into the draw-off bins.

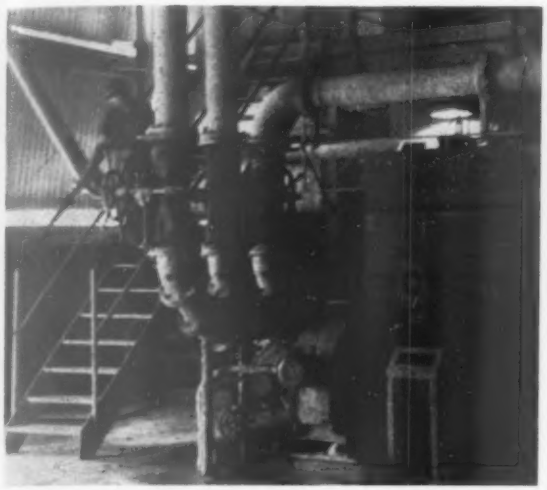


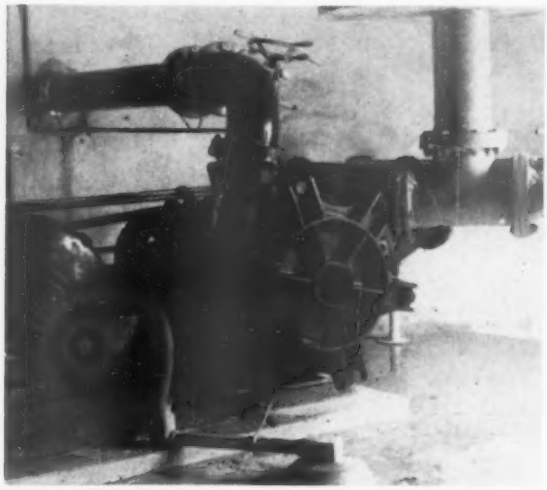
Traveling breaker plate and primary roll crusher combination is effective in preventing clogging when fed mixture of wet marl and stone

Finish Grinding

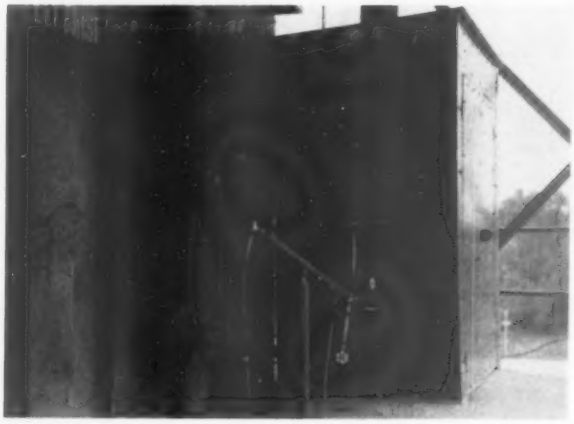
Finish grinding is accomplished by a flexible arrangement of a ball mill, a tube mill and a 16-ft. Sturtevant mechanical air separator which provides a choice of four optional grinding circuits. The circuit most likely to be used is to close circuit the preliminary ball mill with the air separator, return the rejects into the ball mill and grind the fine fraction from the air separator through the tube mill in open circuit. This circuit may prove to be preferred because open circuit grinding through the finish mill would produce more flour in the final product. Capacity with this mill combination is 5000 bbl. of standard portland cement per 24-hr. day carrying a 475 percent circulating load in the preliminary mill circuit.

Alternate circuits would permit (2) passing the ball mill product through the tube mill which would be in closed circuit with the air separator with the reject stream dividing back to both mills, (3) two-stage grinding with the ball mill product being fed the tube mill which would be in closed circuit with the air separator with the rejects all returning into the tube mill and (4) two-stage grinding con-

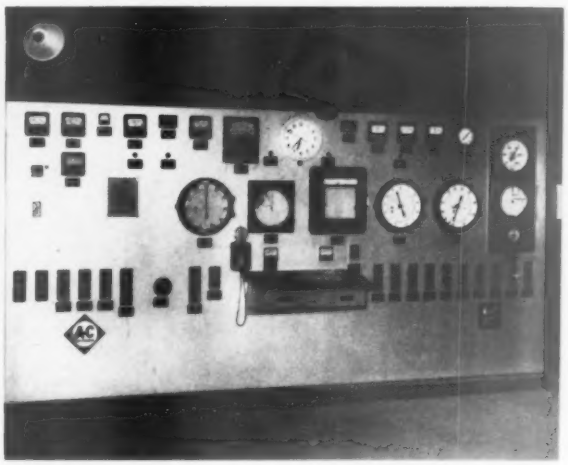




Left: This slurry pump elevates overflow material from the twin screw classifier to overhead slurry screens. Right: Blending slurry pump. There are six blending tanks from which corrected slurry is delivered into kiln feed tanks



Left: Slurry feeder for the kiln. Overflow returns into kiln feed tanks. Right: Gas analyzer records O_2, CO_2 and combined CO and combustibles, as an accurate check on firing conditions in the kiln



Left: Discharge end of inclined grate air-quenching clinker cooler, showing chunk breaker, is shown at right. Air is forced through the clinker bed by fan at left. Right: All instruments for the 12- x 450-ft. rotary kilns and related operations are centralized on this single control panel

Cement is delivered from the finish mill into either of ten 10,000-bbl. silos shown at right. Bulk cement loading is on the right and the packing plant is adjacent to the silos. The transfer from the silos is by cement pump either for packing or bulk loading

secutively through both mills in open circuit.

Having this flexibility will permit actual plant research on the relative economy of the several circuits and on the comparative quality of product. It also allows the tube mill to be cut out for repair while continuing grinding, at reduced rate of feed, through the ball mill-air separator circuit.

Both mills are of Allis-Chalmers manufacture. The ball mill is 10½ x 15 ft. and is driven at 18.2 r.p.m. by a 900-hp. synchronous motor. It carries 124,000 lb. of Molycop grinding media consisting of 8000 lb. of 4-in., 22,000 lb. of 3½-in., 44,000 lb. of 3-in., and 50,000 lb. of 2-in. size.

The tube mill is 8 x 32 ft., driven at 18.7 r.p.m. by an 800-hp. motor and, at present, carries a charge of 80,000 lb. of ⅞-in. grinding media. Both mills are rated at 200 bbl. per hr. capacity. Fuller-Huron Airslides are used to the entire exclusion of screw conveyors throughout the finish mill department for handling mill product, the reject stream and the finished product to the cement pump.

Proportioning of clinker and gypsum is done by separate and interlocked 24-in. Merrick Feedoweights and the ball mill is fed by an 18-in. drag conveyor. Ball mill product is elevated to the top of the air separator, using Airslides for the transfer, with rejects returning to the mill in the circuit now in use, the fines from the separator being elevated to be put through the secondary tube mill. Output of the tube mill is screened on a 3-ft. x 33-in. Tyler Hum-mer screen over a 7-in. Fuller-Kinyon cement pump with two-way valve for transfer into storage. A fringe tank of 800-bbl. capacity was provided. When required, the tube mill product is transferred by the pump into the tank, and when drawn from, an Airslide delivers fringe tank material into the Airslide which feeds air separator fines into the tube mill.

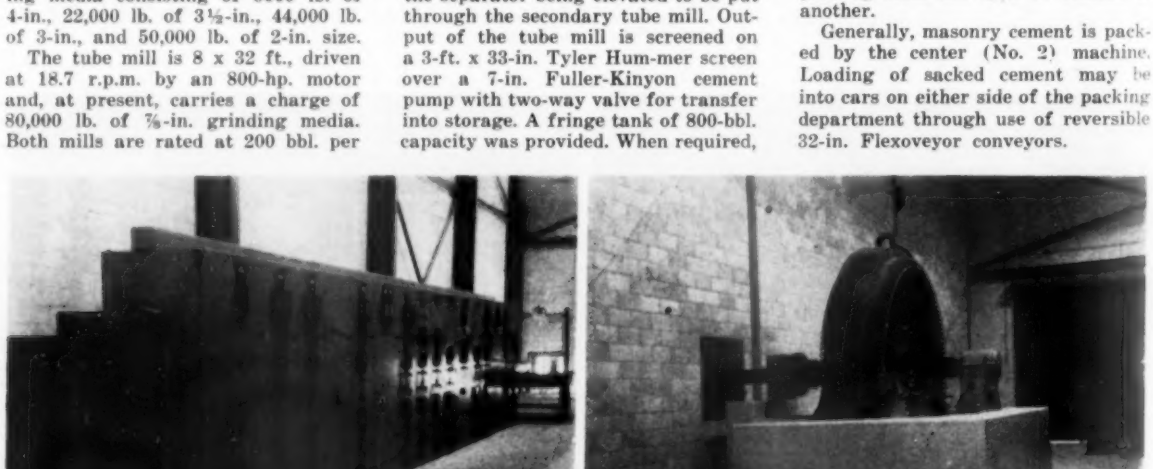
The mill has two Norblo bag-type dust collectors, of 8400 and 13,300 c.f.m. capacity. The air separator is vented through its dust collector for cooling. Dust is conveyed by Airslide to the cement pump.

Packing

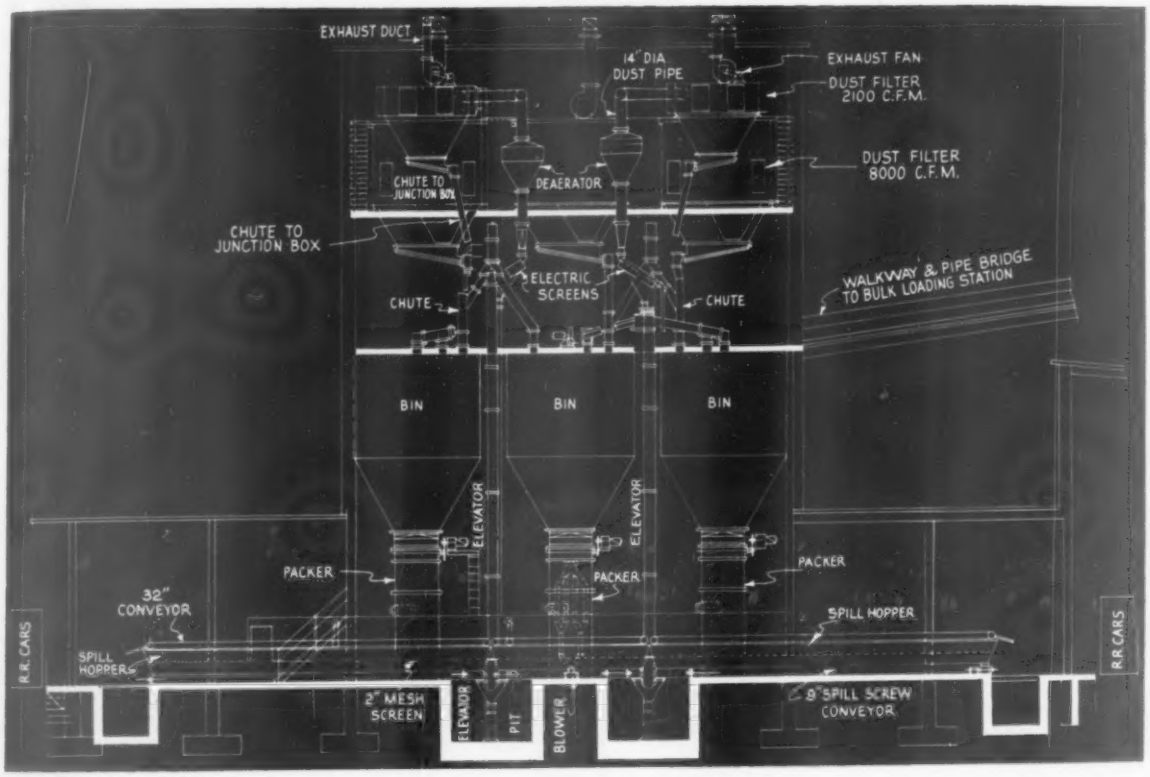
Cement is pumped into any of ten 10,000-bbl. silos arranged in two rows of five. Two rail-mounted 8-in. Fuller-Kinyon type H2 portable pumps transfer cement through separate lines from silo storage either to the packing plant or through parallel branch lines to the adjoining bulk loading plant. The packing plant has three 4-tube Modern packers each rated at 350 bbl. per hour. They are mounted in a row for convenient transfer of bagged cement into railroad cars by reversible conveyor.

Packing was designed for speedy conversion to different types of cement for mixed cars and to minimize the danger of contamination of one type of cement with another. Important to this is the use of divided overhead packing machine bins which allows for separate handling of six cement types. The division head in each bin and appropriate machine feeders permit quick changeover from one type of cement to a second in packing out from one station. The packer operator needs only to clean out the machine hopper and then throw a switch to start packing out from the second compartment. Older plants find it necessary to clean out the entire system before switching packing from one type of cement to another.

Generally, masonry cement is packed by the center (No. 2) machine. Loading of sacked cement may be into cars on either side of the packing department through use of reversible 32-in. Flexoveyor conveyors.



Main power distributing station is an independent motor room, under slight pressure to keep out dust. Left: Main control panels. Right: Synchronous motors drive grinding mills in adjoining mill building

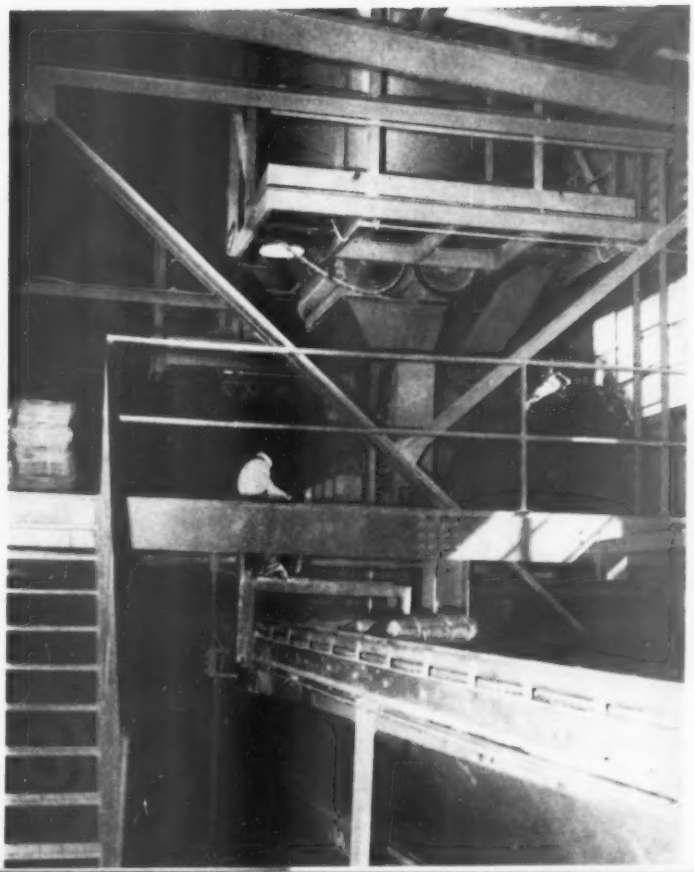


Longitudinal section through packhouse

Incoming cement to the packing plant is discharged from the two separate lines into separate 5-ft. deaerators overhead, each of which is vented by a 2100-c.f.m. Sly bag-type dust arrestor. The cement from each deaerator is discharged over a 4- x 5-ft. Tyler Hum-mer vibrating screen and is then distributed from a junction box by Airslides into the selected bin. Either stream may serve the middle masonry bin as well as No. 1 or No. 3 station. The bin over each packing machine holds a total of 700 bbl. of cement which is divided into two 350-bbl. bins. Each packing machine is vented by an 8000 c.f.m. Sly dust arrestor. Products from the dust arrestors are discharged into the packing machine bin involved.

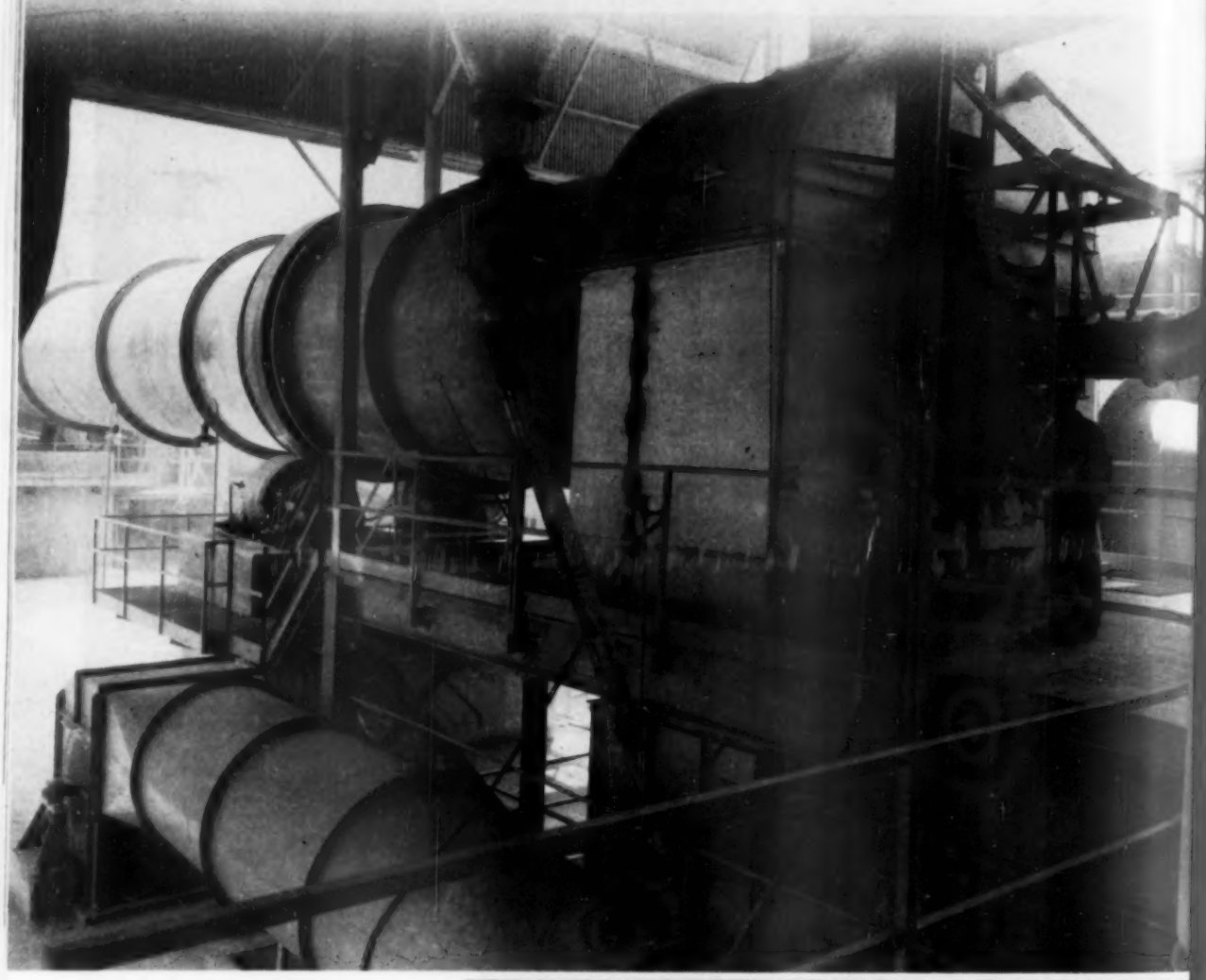
Airslides are used exclusively for conveying with the exception of a 9-in. spill screw conveyor below and two bucket elevators to return spill into the packing machine tanks. The elevators are located, one between stations 1 and 2 and the other between stations 2 and 3. Under station 2, the spill screw conveyor is reversible to serve either elevator.

(Continued on page 190)

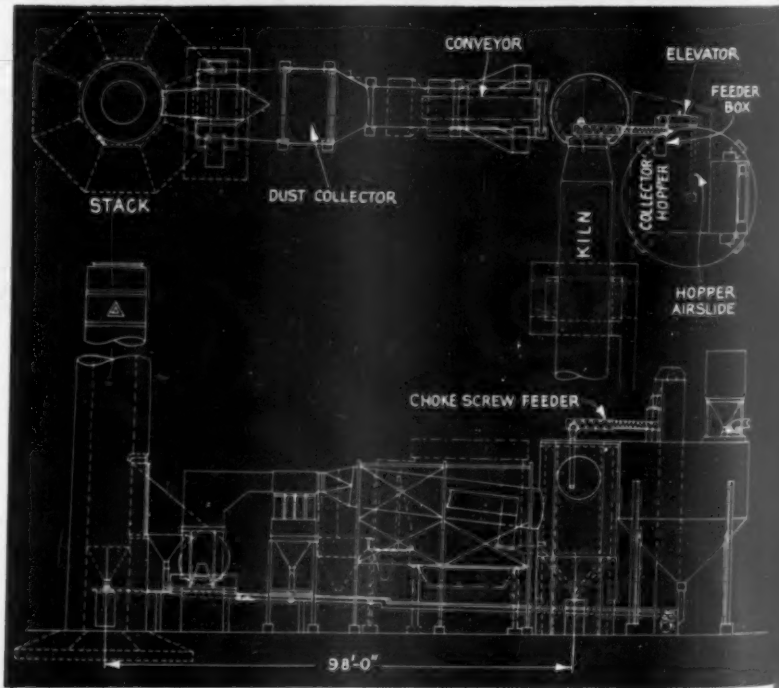


There are three packing machines, each 350 bbl. per hr. capacity, which have divided overhead feed hoppers to permit quick changeover from packing one type of cement to another. Bagged cement is moved into railroad cars by reversible conveyor

CEMENT



Above: Firing end of 11- x 390-ft. dry process kiln. Air-quenching clinker cooler may be seen directly under kiln hood, with blower fan and duct on left and clinker dust trap above



Right: Drawing of kiln end showing feed hopper and related equipment

AMERICA'S LARGEST DRY PROCESS CEMENT KILN

By BROR NORDBERG

New 11- x 390-ft. rotary kiln of Louisville Cement Co. at Speed, Ind., highly instrumentalized with many automatic firing controls. Automatic proportioning controls regulate raw mill feed

INSTALLATION OF AN 11- x 390-ft. dry process rotary kiln and rebuilding of the raw mill for 50 percent increased capacity at the Speed, Ind., mill of Louisville Cement Co. have stepped up the rated annual output of the plant from 1,825,000 bbl. to 2,500,000 bbl. of portland cement. This program, completed in late 1951, followed a major rehabilitation and improvement program in 1948 and 1949 which was carried forward to greatly improve mill efficiency without added over-all mill output at the time. The earlier project had comprised a new finish mill department, a 10- x 150-ft. rotary kiln to replace two 7- x 100-ft. units, installation of three waste-heat boilers with economizers and electric precipitators for stack dust collection, and related equipment. It was described in the August, 1949, issue of ROCK PRODUCTS, pages 136-139.

The new kiln is the largest and longest dry process rotary kiln in America. It is operated without waste-heat boilers in a plant that has always been a waste-heat operation with short kilns. Three 10- x 150-ft. kilns and two 8- x 10- x 160-ft. units, with waste-heat boilers, are also in production, which gives opportunity for comparison of costs when using identical raw materials and fuel in a single plant.

Long vs. Short Kilns

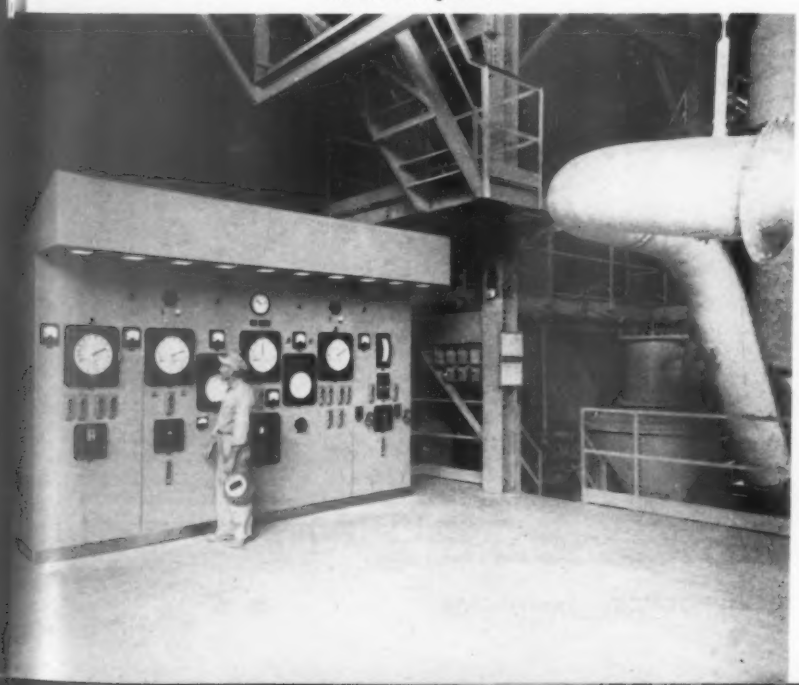
Each of the 150-ft. kilns produces 1125 bbl. of clinker per day and each of the 160-ft. units averages 1000 bbl. per day. The big kiln has not yet been pushed to its rated capacity of 2700 bbl. but is averaging 2500 bbl. with a fuel requirement of 900,000 B.t.u. or slightly less per bbl. of clinker. All the kilns are direct-fired with pulverized coal. On the basis of quantity of coal, the comparison is 78 lb. per bbl. against 105-115 lb. for the shorter kilns. An average figure would be 28 percent less fuel, considering the entire fuel input for clinker production and waste heat power generation combined with the short kilns, in making the comparison. However, the short kilns have no clinker coolers for preheating secondary air for combustion whereas the long kiln has an inclined grate clinker cooler of the air-quenching type.

Investment in equipment per barrel of output, in view of high capital costs for boiler and generating equipment, also indicated that a long, dry process kiln was the best investment even though a small fraction of the power requirement must be purchased to supplant that generated by waste-heat boilers and a stoker-fired auxiliary boiler.

There are a number of unique features to this kiln installation. It is highly instrumentalized as are the majority of modern long kilns but it utilizes more automatic controls than for the average kiln. Emphasis is on the avoidance of breakdowns and variations in operation, with alarms and indicating lights provided for all critical operations. Among the instruments, a continuous O_2 and a combustibles analyzer are of extreme importance and special precautions and pains have been taken in installation and operation so that the burner may rely on the readings. An instrument new to the industry provides automatic draft control for the clinker cooler to permit maintenance of uniform draft into the kiln hood.

Limestone coming from the quarry at Speed is of high quality and of sufficiently uniform composition that no special facilities for blending were needed. Stack dust as recovered in a cyclone-type collector is returned into the kiln continuously and none of it is discarded. The kiln has an independent stack.

Controls for all operations of new kiln are centralized on this panel. To the right may be seen the direct-firing coal mill

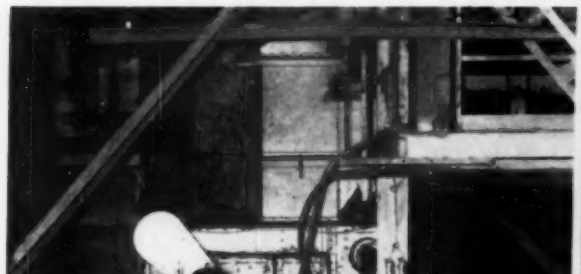


Kiln

The kiln is of F. L. Smidth manufacture with $\frac{1}{16}$-in. pitch and is carried on five supports consisting of solid cast steel fully floating tires, cast steel supporting rollers and kiln bearings incorporating a ball and socket joint for self-alignment. The kiln gear is attached to the kiln shell by spring plates and shackles which permit free expansion and contraction of the kiln shell.

It is lined throughout most of its length with 6-in. refractory brick. The burning zone carries 9-in. 70 percent alumina brick with the exception of 20 ft. in the hot zone which is lined with 6-in. burned magnesite basic brick. Then follows 6-in. 60 percent alumina brick and lower heat-resisting types back to the feed end of the kiln. Both the hood end and the feed end are tight fitting to minimize air leakage and have air-cooled rings.

Kiln feed is synchronized with the operating speed of the kiln through the conventional Smidth system. An alternator is connected to an extension of the kiln motor shaft through a flexible coupling, which generates a-c power of varying frequencies for driving the kiln feed motor. Between the feeder motor and the kiln feeder, a Link-Belt PIV variable speed unit



Left: With installation of 11- x 390-ft. rotary kiln, raw material production was proportionately increased. Here is shown new heavy-duty hammermill for shale. Right: Two feeders, one for limestone and one for shale, feed a preliminary raw grinding mill. Proportions of each material are automatically maintained even if the feeder belt speeds are changed. Total weight fed is held automatically to conform with preset amperage on mill motor

permits independent adjustment of the feed rate.

Kiln Drive

The kiln is driven by a 125-hp. shunt-wound, adjustable speed Allis-Chalmers d-c motor (900/225 r.p.m.), the motor being supplied d-c current from a generating unit installed especially for the purpose. The unit consists of a 200-hp. Elliott turbine geared to drive an Allis-Chalmers 125-kw. d-c generator. The turbine is of the non-condensing type; the exhaust steam is used for processing boiler make-up water instead of using a pressure reducing valve in connection with boiler operation. The generator is also the source of d-c current for the variable speed drive on the clinker cooler grate.

Coal Firing

Firing of the kiln is with a No. 533 Raymond direct-firing coal mill driven from a 200-hp. motor. Heated primary air for mill operation is drawn from the top of the kiln hood, and is put through an 8-ft. dia. dust trap ahead of the mill. Clinker dust joins the clinker stream below the cooler. The primary air-coal mixture is injected into the kiln through a 13-in. water-cooled burner pipe.

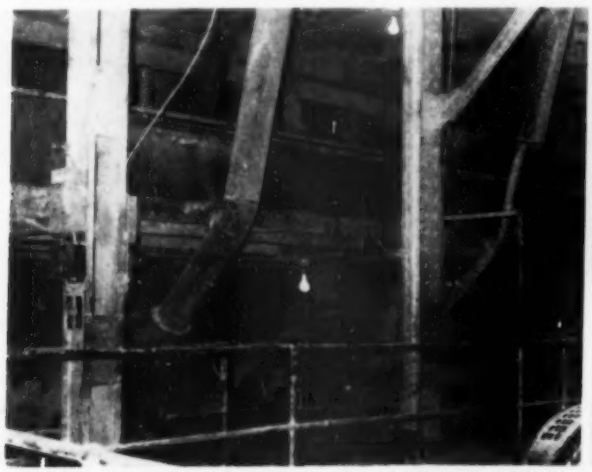
One of the troublesome variations in firing has been minimized through a coal blending bin system. It consists of a long bin of 350 tons capacity. The bin has no partitions but has six draw-off hoppers below to a pan conveyor from which coal mill feed bins are filled. Coal is drawn from several hoppers simultaneously in blending, coal from different sources and of varying properties being placed in different parts of the bin. Both Kentucky and Indiana coal are used, averaging 13,000 B.t.u. per lb., dry basis but containing about 10 percent moisture by weight in storage.

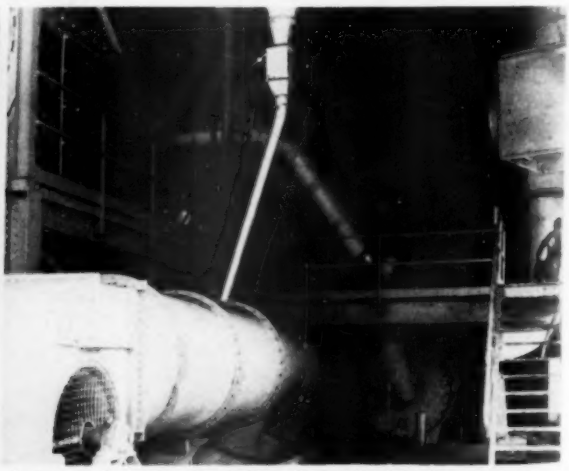
An accurate check is kept on coal consumption in the long kiln, the coal mill being fed 200-lb. batches of coal from an overhead 37-ton bin by a Richardson weigh batcher.

Kiln Feed

The kiln is fed raw material by a constant-head feeder arrangement designed in cooperation with Fuller Co. engineers. Feed material is first pumped from the blending tanks into a 28-ft. dia. steel tank of 450 tons capacity. This tank is cylindrical with conical bottom and has four open-topped F-H Airslides to aerate the bin. These Airslides are equally spaced and run up the hoppered bottom of the tank.

Kiln feed is drawn from the bottom of the tank through a 14-in. Fuller rotary valve to an F-H Airfeeder and is conveyed by 10-in. Airslide into the boot of an enclosed bucket elevator which discharges into an over-





Left: Tube mills in raw grinding department are fed from an overhead circulating supply stream. Excess from the overhead feed screw conveyor is returned continuously into a bin by the return screw shown just above the mills. Right: Direct-firing coal mill is on right with coal batch scale overhead. On left is duct and fan for air-quenching clinker cooler

head constant-head chamber. The weir in this chamber maintains a constant level of feed material and a choke screw conveyor feeds a regulated amount into the kiln feed spout. Excess material over the weir is spouted into the kiln feed tank. A Norblo dust collector vents the hopper, elevator and the incoming F-K line to the feed tank.

Several safety devices were provided to insure correct and uninterrupted operation of the feed system. A Bin-Dicator set into the boot of the bucket elevator prevents overloading. If the elevator is overfed with material, the air supply to the Airfeeder and Airslide from a positive rotary blower is automatically cut off and then both the rotary valve and a swing gate at the junction of the Airslide to the elevator are closed. Mercoid switches, time delay relays and solenoid valves are used to operate these devices to stop the feed to the elevator.

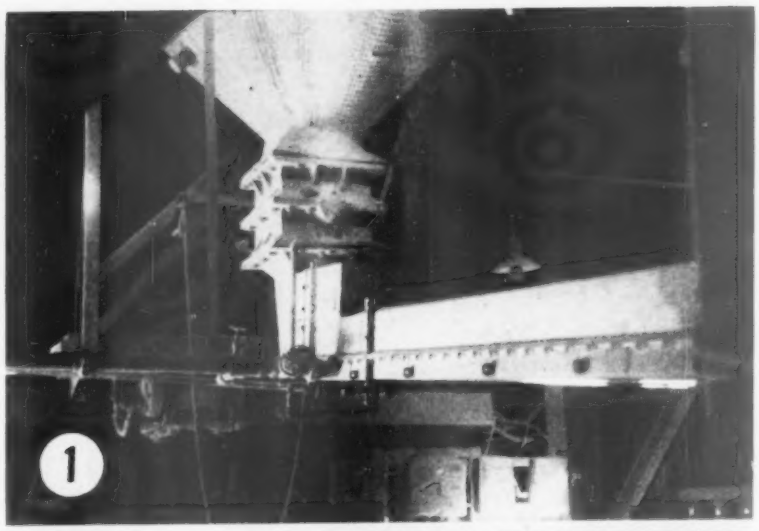
If material in the constant-head chamber should fall below the weir level, a horn is sounded. It is the choke screw drive that is tied synchronously with the kiln speed rate. A valve at the junction of the screw with the kiln feed pipe is the means, through a mercoid switch, of actuating a blinking light and also an alarm at the burner's platform if the flow of feed be interrupted. Bin-Dicators on the kiln feed tank indicate when the tank is nearing empty or full.

Exit gases from the kiln are drawn through a Western Precipitation Multiclone dust collector by a 7½-ft. dia. induced draft fan, and exhaust through a 9- x 200-ft. Rust concrete stack. The fan is a Sturtevant double-inlet type rated at 120,000-140,000 c.f.m. Temperature at the fan is held, through automatic adjustment of the louver dampers ahead of the dust collector, not to exceed 750 deg. F.

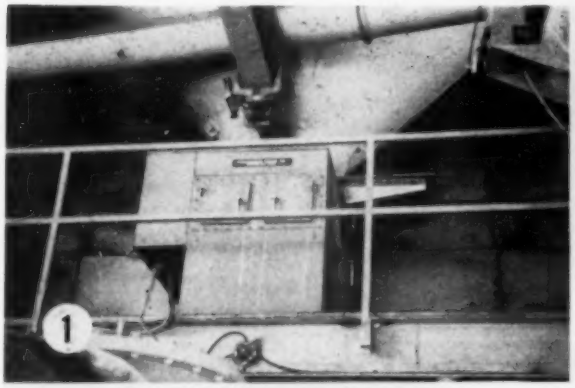
Efficiency of the dust collector is approximately 80 percent and all the dust recovered is returned into the system. Discharge is continuous into a long horizontal screw conveyor which feeds the dust into the bucket elevator which supplies the constant-head kiln feeder. Rate of dust return is 70 lb. per minute.

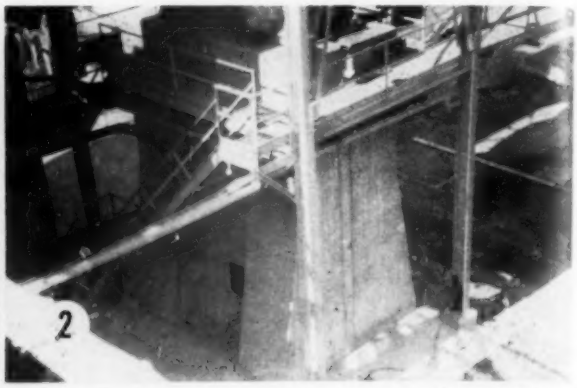
Clinker Handling

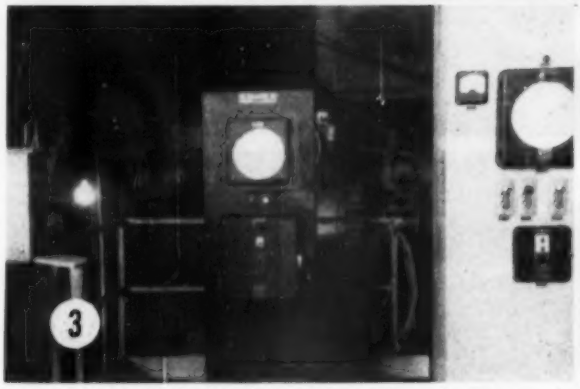
Clinker is discharged over a Fuller No. 733 air-quenching, grate-type clinker cooler which has provision for later installation of a clinker breaker at its discharge end if proved necessary. The product is cooled to 180



1—Kiln feed is drawn from tank through rotary valve and air-activated gravity conveyor to bucket elevator, which discharges into overhead constant head chamber. 2—Raw material from air separators is conveyed by air-activated gravity conveyor to cement pump for delivery into kiln feed tank. 3—Pair of feeders, one for limestone and one for shale, feeding a preliminary raw mill







1—Coal is batched before it is fed into direct-firing coal mill as record of kiln efficiency. 2—Gas analyzer equipment is maintained under controlled temperature conditions, free from dust, in an enclosed room under one of the kiln support piers. 3—Automatic draft controller for clinker cooler stack is means of getting uniform draft into hood of kiln. 4—A non-condensing type turbine drives 125-kw., d-c generator for kiln drive. Exhaust steam is used for processing boiler make-up water

deg. F. and placed into storage by an inclined pan elevator. Clinker from this kiln is stored in a separate area, or pocket, so that production may be checked fairly closely in rehandling by a level-full 3½-cu. yd. clamshell bucket.

Approximately 11,000 c.f.m. of the total 30,500 c.f.m. of cooling air forced through the cooler grate is preheated secondary air for combustion. The drive on the grate is a rheostat-controlled d-c motor for speed variation, and the speed may be either automatically or manually controlled.

Instrumentation

The main instrument board is a Leeds and Northrup panel and all the principal indicating and recording instruments are L&N with the exception of a Bailey draft recorder and Bailey recorder for O_2 and combustibles in the exit gases as determined by Bailey continuous gas analyzers.

In conjunction with the kiln there are 17 other coordinated motor-driven elements which come under the control of the burner at the centralized panel. The board, in addition to its principal instruments, also serves as a centralized push button station and has green running lights for each motor, ammeters for each major motor drive, various alarms, signal lights and meters. The various key instruments and their functions follow.

Cooler bed speed control is automatically regulated by a "positive adjusting type control" which changes the clinker bed grate speed according to temperature requirement as measured by a thermocouple over the clinker bed in the hot end of the cooler. It automatically corrects for rises or decreases in temperature and has automatic resetting at the desired temperature. A Speedomax indicates and records this temperature on the board, it being the desired holding point for secondary air temperature. Grate speed can also be changed manually by setting the rheostat on the drive. The holding point is 1050 deg. F. The ammeter for the fan motor drive is also an indicator, too low a reading indicating insufficient air coming through the clinker bed.

The cooler also has automatic draft control for the exhaust stack which is a relatively new feature in the portland cement industry. An L&N automatic draft control on the cooler stack and a Hays draft recorder combine to hold a constant draft as measured at the hot end of the cooler just below entry of preheated secondary air into the kiln hood. The reading is held at 0.02 in. w. g. to maintain constant draft entering the kiln. A louver damper is actuated to hold a uniform pressure of air entering the kiln. This control compensates for variations in draft due to stack conditions as influenced by atmospheric changes or changes in cooler operation. A slight negative pressure is preferred at entry into the kiln.

Temperature in the hot zone of the kiln is recorded on a Speedomax (L&N), the holding figure being 2700 deg. F. A Rayotube with special filter circuit to strike an average, focused through the kiln hood on the hot lining, records the reading. Principal function of this instrument is to warn of excessive temperatures that would be detrimental to lining life and to give warning of upsetting conditions within the kiln.

A Speedomax indicates and records the kiln exit gas temperature, which is about 1200 deg. F. as measured at the back end of the kiln, and an Electromax rear-end temperature controller automatically opens and closes the cold air damper at the rear end so that exhaust gases may not exceed 750 deg. F. into the induced draft fan.

A Bailey instrument records both hood and back end draft, the differential between the two readings being

an indicator of ring formation in the kiln and also reflecting in increased dust loss in the exit gases. To accomplish adjustment in hood draft, a drive unit with push button controls adjusts the damper on the exit flue of the kiln to compensate for variations in fuel supply, air volume and weather, thus being the means to hold the burning zone.

An Electromax controller regulates the temperature of the primary air-coal mixture coming out of the direct-firing unit mill. A resistance thermometer detects the temperature and the controller activates a drive mechanism which automatically makes adjustment to the cold air bleed-in damper. The temperature of the air is maintained at about 400 deg. F. into the mill in holding a primary air-coal mixture temperature of 180 deg. F. The coal mill also has the Hagan mill level control which maintains a uniform amperage load on the mill motor.

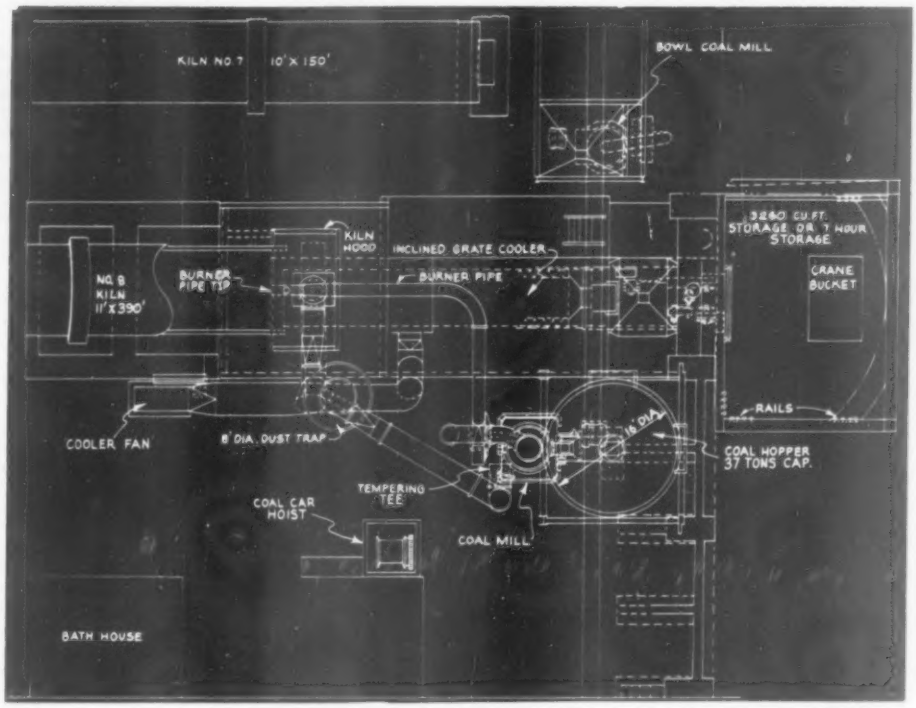
A Speedomax speed recorder is used to set the speed of the kiln. Changes to kiln speed are made by adjusting the rheostat to arrive at the desired reading which has been established at 65 r.p.h. The effect is quick and an accurate record is kept of starts, stops and speed changes.

A single L&N master instrument inside the cubicle records the coal-air mixture temperature, temperature of the air into the unit mill, the draft fan temperature and the exit gas temperature. This provides a record, on a single sheet, of readings critical to continuity of kiln operation.

Ammeters are provided on the board for the principal motors including the cooler blower, kiln drive, feed elevator, coal mill, draft fan and cooler drive. Start-stop switches are also located here for all equipment related to the kiln and there are green lights to indicate that equipment is operating, including the clinker conveyor, cooler, cooler blower and cooler dust screw conveyors.

Other instruments include:

- Kiln revolution counter
- Feed screw revolution counter
- Hood draft damper position indicator
- Coal mill draft
- Voltmeters
- Alarms and flashing lights to indicate high combustible gas, high O_2 in the exit gases, high cooler temperature, feed failure and high temperature at the induced draft fan
- Telephone between burner floor and back end of kiln

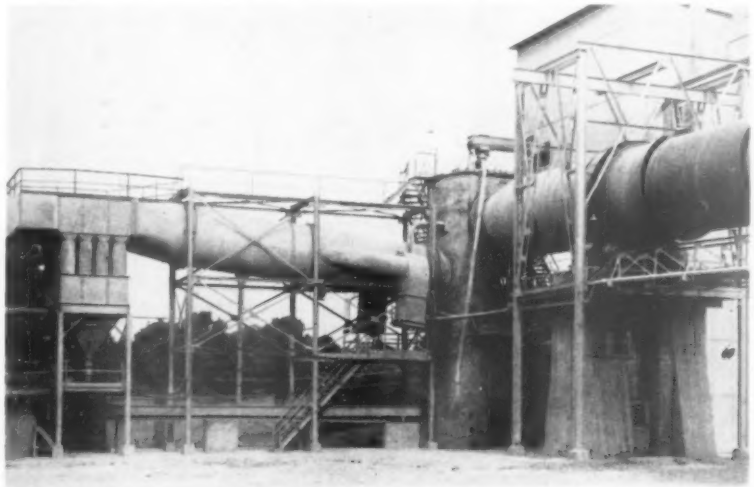


Layout of 11- x 390-ft. kiln, cooler and related equipment at discharge area

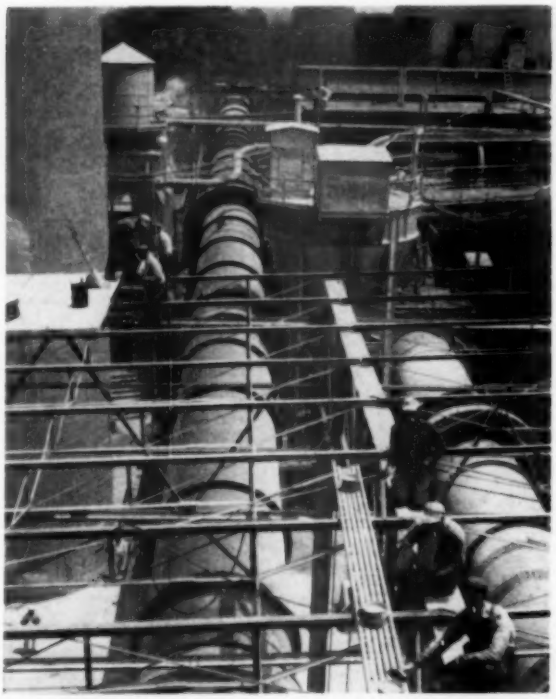
Operating a long rotary kiln was a new experience for the burners at this mill so an instrument chart was devised for fill-in of readings that has been important in helping educate the burners to the use of the many instruments. The men have become quickly sold on the value of instruments and have come to rely on their use for operation of the kiln.

Gas Analyzers

Most essential of the instruments insofar as fuel efficiency is concerned are the draft control, the speed recorder, and the O_2 and combustibles analyzers. The latter instruments have come in for special attention based on the company's experience with this equipment on one of the 10- x 150-ft. kilns and because ac-



Feed end of kiln showing stack dust collector on left. Dust from this unit is returned continuously into kiln feed system by horizontal conveyor just above ground. Gas analyzer equipment is housed under the kiln pier at right



Partial view of longest dry process cement kiln in the Western Hemisphere, looking toward feed end. In center is constant-head feeder for the adjoining shorter kiln

curate and dependable exit gas sampling is difficult in a dry process kiln because of the greater dust loading.

The particular oxygen analyzer selected has a relatively trouble-free sampling system, the sampling pipe having a spray nozzle which produces a water screen inside the entrance to the sampler. Every precaution is taken to insure that the readings as taken be correct in order that greatest possible fuel economy be achieved and to guard against secondary combustion at the back end of the kiln with its hazards of explosion.

The instrument has been relatively free from operating troubles and the sample pipe has never become clogged in this installation. The pipe is blown down daily by introducing compressed air through the sample line and pipe in the reverse direction to the sample flow.

Should the spray nozzle holes have a tendency to be stopped up, practice is to blow down the sample tube every 12 hr. The sample tube is water cooled in the case of this instrument. Recommendations of the manufacturer are followed and the sample pipe is sloped uphill to an angle over 15 deg. from the horizontal and, in the case of the long kiln, rests on an alloy steel post welded to the feed pipe support beam.

The analyzer is located in a special enclosed room of concrete block construction which is under one of the kiln support piers. It is about 30 ft. distant, both horizontally and vertically, from the sampling tube. This special room was built so that the instrument may be operated under ideal, controlled conditions in an atmosphere free of dust and where elevated temperature may be maintained to prevent condensation. Condensation, after removal of water by the float trap, is the cause of stoppages in the small opening passages, which have contributed to failures and faulty readings with the use of many gas analyzers. Filters can also become stopped up for the same reason, weather changes being a factor, so the entire unit is completely housed in a plywood cabinet. Strip heaters inside the cabinet are thermostatically regulated to maintain a temperature of 110 deg. F. The cabinet is vented to remove corrosive gases and the room temperature is also kept constant. It is equipped with a space heater for use in cold weather.

Having the unit located on the ground level makes it convenient to take care of the instrument. A one-piece "Saran" plastic tube of ½-in. outside diameter is the coupling between the sampling tube and the analyzer, as an effective solution to the problem of corrosion. Sulfurous acid, formed by sulfur compounds in the gases in the presence of water, are not injurious to the plastic tubing. A complete spare separator trap assembly is kept on hand for an easy change, should accumulated material in the trap prevent separation of water and permit its carry-over into the analyzer.

Based on experience with gas analyzers, the company believes that the use of the combustibles analyzer is important along with the oxygen analyzer as a check instrument. The kiln burner adjusts his combustion air or fuel to obtain as low an oxygen reading as possible without getting any or just a small and occasional combustible gas reading. As the accuracy of the oxygen analyzer gets off, combustible gases are indicated at about ¾ of one percent rather than at the more accurate reading of about 1/10 of one percent excess oxygen.

When operating under conditions of a bad ring in the long kiln, the figure must be as high as 3 percent excess oxygen to avoid unburned combustible gases. The combustible gas analyzer is almost trouble free.

If 2 percent combustible gases is recorded for more than two minutes, a horn blows and the burner immediately cuts out the coal feed until the condition corrects itself. Otherwise, the draft fan could be quickly overheated and there would be danger of explosion. The combustibles analyzer is checked with test gases at regular intervals for calibration.

There are two warning lights on the recorder. Under normal condi-

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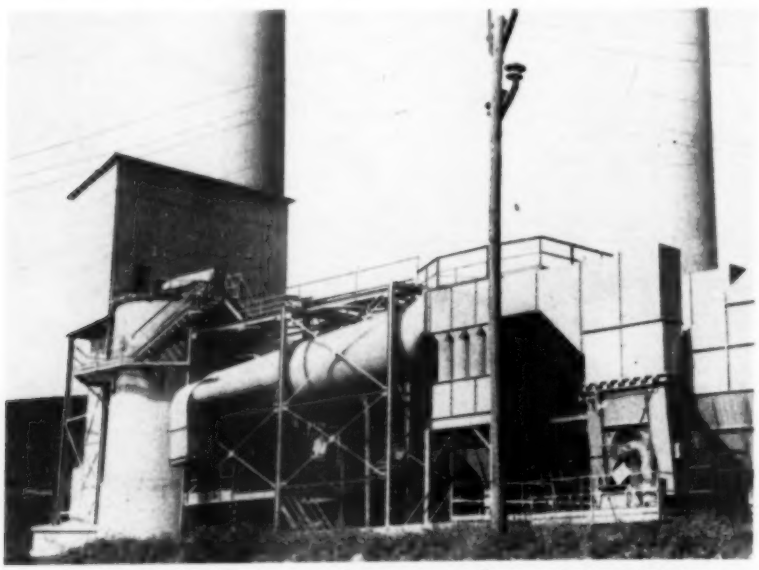

View of back end of kiln showing cyclone-type stack collector and induced draft fan

"PROSPECTIVE" CHEMISTRY OF CEMENT AND CONCRETE

Part II. What holds atoms together?

By NATHAN C. ROCKWOOD

IN THE FIRST ARTICLE of this series, in the July issue, we attempted to explain to the uninitiated what atoms of some of the elements are like—those elements with which we are chiefly concerned in the chemistry of cement and concrete. An understanding of the physical structure of an atom is considered fundamental, but not of very much practical value to the researcher in cement and concrete, at least in this stage of research development. Discrete (that is, isolated or separate) atoms or ions are rarely encountered in common inorganic or mineral chemical structures. They exist primarily only in very dilute solutions and as gases or vapors. In mineral structures atoms, or ions, and molecules are bonded together, often in large groups and in complicated ways, with other atoms or ions, according to generally accepted laws of ionic coordination, the chief one of which is that the structural organization of the unit as a whole must be neutral, that is, positive and negative ionic charges must be balanced.

It is well to keep in mind, however, that every material with which we deal has atoms and ions exposed on its surfaces. Thus when we discuss the "surface characteristics" of an aggregate in concrete, we are dealing not only with such physical characteristics as smoothness, roughness, or porosity, etc., but with possible chemical reactions between the surface ions of the aggregate and the free ions in the liquid or on surfaces of the matrix surrounding the pieces of aggregate. In other words, the bond between the matrix and the aggregate may have, and probably always does have, a chemical as well as a physical character. "Surface" chemistry is still chemistry, although it deals primarily with reactions between particles of appreciable size instead of with reactions between discrete atomic ions or molecular ions. So far as is known the same kind of reactions occur in both instances, but the larger the particle size the less intense or appreciable is the reaction. This should be kept in mind for a subsequent discussion of the important part colloid and surface chemistry plays in cement and concrete research.

Atomic Bonding

Before the development of modern structural chemistry, textbooks merely accounted for the joining up of atoms and molecules to form appreciable amounts of various substances as "chemical affinity." It is now possible to explain this affinity by the interaction of the "valence" electrons of one or both atoms of the reacting elements. We have described in the first article how each element is composed of a central nucleus of positively charged protons and about an equal number of neutrons, which carry no charge, surrounded by concentric shells of negatively charged electrons. The electrons in the outermost shell are called the valence electrons—the only ones which ordinarily take part in chemical reactions. When these outermost shells have their complete quotas of electrons, 8 in those of the lower orders, and 18 in the higher orders, they are relatively stable, or inert. They don't react readily because they have little tendency to acquire or release any of these electrons.

Thus, chemical affinity is the tendency of an atom with four or less electrons in its outermost shell to become a stable *ion* by losing its valence electrons to an adjoining atom, and the tendency for an atom with four or more electrons in its outermost shell to acquire electrons to complete its quota of eight. (In the case of a required 18 in the outermost shell, of course, it is 14 or more.) The simplest way for this to occur is for the electrons to be transferred from one atom to another, resulting in changing the reacting atoms to positively and negatively charged ions. A good example of this is calcium chloride, $CaCl_2$. As we have seen from the atomic structure of calcium (July issue) it has two electrons in its outermost shell. These are its valence electrons; hence its valence is two. Brought into contact with chlorine, which has seven electrons in its outermost shell and needs one more to complete its quota of 8, the calcium atom releases one of its electrons to each of two chlorine atoms as shown in Fig. 3. This exchange results in a calcium ion having a positive electrical charge of 2, and two chlorine ions, each with a negative electrical charge of 1; or we have a calcium ion designated Ca^{+2} and two chlorine ions designated $2Cl^{-1}$. These oppositely charged ions attract each other, just as the opposite poles of a magnet attract each other.

The diagram, Fig. 3, is merely to illustrate the transfer of the electrons of the calcium atom to the two atoms of chlorine. The calcium chloride molecule itself, having the positive and negative charges balanced, as a whole is neutral, but the ions are joined probably somewhat as shown in Fig. 4, instead of the chlorine ions being on opposite sides of a calcium ion as illustrated in Fig. 3. Thus the molecule actually has two

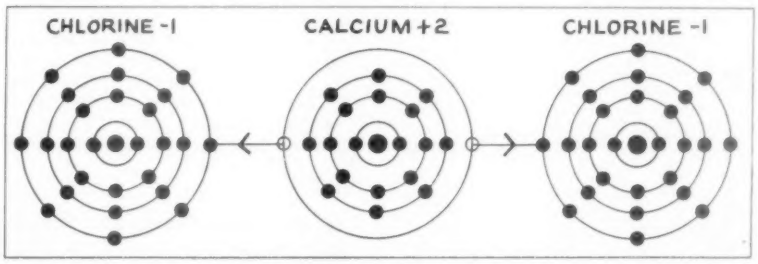

Fig. 3: Transfer of two electrons of an atom of calcium, one to each of two atoms of chlorine to form one molecule of calcium chloride ($CaCl_2$)

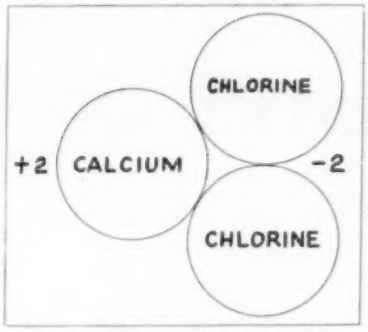

Fig. 4: Polarized calcium chloride molecule

poles, one positive and one negative, or is polar, so that the negative chlorine side or end is attracted to positively charged ions, and the positive calcium side or end to negatively charged ions. Thus calcium chloride is attracted to or reacts with a positively charged ion of a metal like iron through its negatively charged chlorine pole, or with a negatively charged ion of a nonmetal like sulfur through its positively charged calcium pole. In such manner various mineral "complexes" are built up and bonded together.

Ionic Bonds

The kind of a chemical bond described above, that is, attraction between oppositely charged ions, is usually called an ionic bond in English technical literature. Hückel, in his "Structural Inorganic Chemistry," reviewed in our "NOTES" page for July, terms it a "heteropolar" bond, meaning that it has different poles. It is the kind of bond found in many salt-like materials; it is not the strongest kind of bond, and it may be broken in electrolyte solutions by passing a current of electricity through the solution. Thus when a current of electricity is passed through a solution in water of calcium chloride, the bond between the calcium and the chlorine ion is broken and the two ions are separated. The positively charged calcium ions are drawn to the negative terminal of the electrical current, the cathode, and are called cations; the chlorine ions go to the positive terminal, or anode, and are called anions. This, incidentally, is the electrolytic method of recovering metallic calcium, or in the case of magnesium chloride, the metal magnesium.

The bond between calcium and oxygen forming calcium oxide, or common lime, is presumed to be of the same ionic or heteropolar nature. Here the calcium gives up its two valence electrons to a single atom of oxygen, as illustrated in Fig. 5. This is a double bond, and hence a much stronger one than the bond between calcium and chlorine. Thus CaO is only very slightly soluble in water and therefore cannot be separated by solution and electrolysis into calcium and oxygen ions. Single molecules of CaO or lime do not exist except probably in very dilute solution or in vapor form. As will be explained later, calcium in the minerals we are interested in is said to be 6- coordinated with respect to oxygen, in most known instances (Fig. 5A). It can be 8- coordinated in some combinations. This does not change the chemical formula CaO, for each O is also 6- coordinated with respect to Ca, as will appear evident in the discussion of silica that follows.

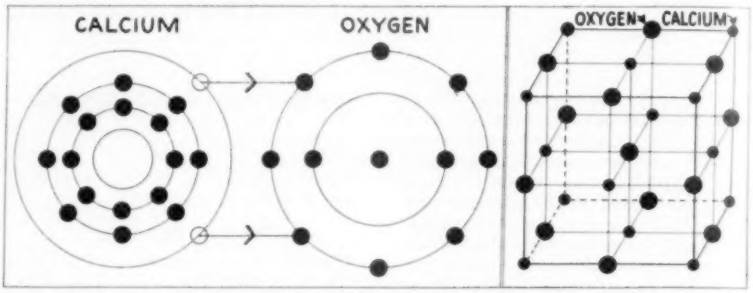

Fig. 5, left: Transfer of two electrons from atom of calcium to atom of oxygen to form calcium oxide or lime. Fig. 5A, right: Structure of lime, CaO

Valence Bonds

As structural chemistry developed it was seen that the transfer of electrons to form ionic bonds between atoms would not explain all the known combinations. For example, oxygen, although by far the most plentiful element in nature, never occurs in the form of discrete atoms in a free state. The atmosphere is about 23 percent free oxygen gas, but the oxygen is in a relatively less active form as oxygen molecules of two combined atoms of O, or O_2. That is why in combustion calculations one has to deal with molecular weights of O_2 instead of with atomic weights of O. The way in which these two atoms of oxygen are bound together is illustrated in Fig. 6. With a gap of two missing electrons, in order to complete its quota of eight so far as possible in the outermost shell of each atom, a part filling is accomplished by each atom sharing two electrons in common. This is termed a valence bond in English literature and a homopolar bond by Hückel. In the case of oxygen this combination leaves the molecule with two joined ions whose electrons are still short of the 8 each required for chemical stability, so that even the molecule of oxygen is active chemically, having a negative valence of 2, or the capacity to take on two more electrons. Thus atmospheric oxygen unites with the positive ions on the surface of metals to form oxides, or in the case of iron, rust.

Van der Waals Bonds and Others

When inert gases are solidified by low temperatures and high pressures, crystals are formed, which are held together by bonds which cannot be classified as either ionic or valence bonds. The bonds which hold such crystals together are not fully understood. It is apparently a kind of cohesion from mere proximity of the like atoms. It is a weak bond easily destroyed by heat or release of pressure. This is called a Van der Waals bond, or Van der Waals forces, after the discoverer. Apparently this type of bond does not figure much in the kind of mineral chemistry considered here.

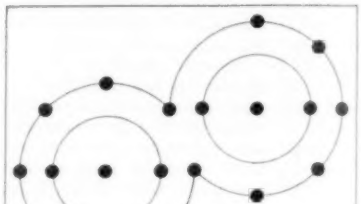

Fig. 6: Sharing of two valence electrons by two atoms of oxygen to form a molecule of oxygen, as is found in the atmosphere

There is also a type of bond called a metallic bond, which unites the atoms of metals into crystals. This is stronger than Van der Waals forces, and is accounted for by interaction between the clouds of free-moving electrons which surround the metal atoms. Since in cement and concrete chemistry we are not dealing with metals as such (in the metallic state) we are not greatly concerned with metallic bonds.

In mineral or inorganic chemistry in general, we are dealing with mixtures of ionic and valence bonding, since pure types of either kind appear to be uncommon. A good example of a mixed type bond is silicon dioxide or silica (SiO_2). It is possible that single molecules of silica with a double bond between the silicon atom and two oxygen atoms exists in a vapor state, but in all the known forms of silica, the silicon atom is bonded to not two but four oxygen atoms.

Silicon Dioxide (Silica)

We shall find silica the most inter-

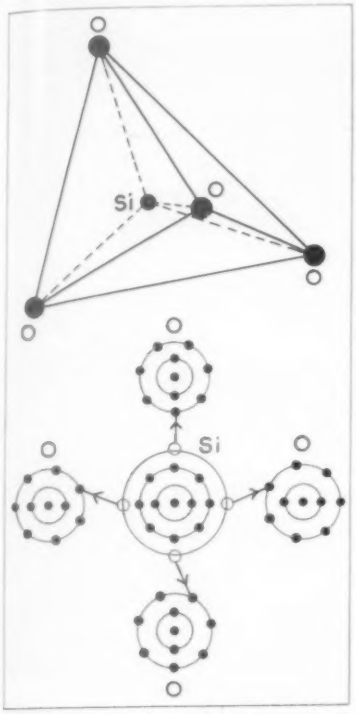

Fig. 7. Top: Silica tetrahedron; the center O is above the plane of the sketch. Full lines show tetrahedron; dashed lines show bonds between silicon and oxygen. Bottom: Bonding of silicon ion to four oxygen ions to form cell of silica

esting mineral we have to deal with, for if the silicates formed on the hydration of portland cement bear any resemblance to all the natural silicates, it should be possible to develop the structure of hardened cement without too much difficulty. Silica, moreover, is the most important mineral in nature since it comprises some 60-odd percent of the entire lithosphere, or crust of the earth, being the principal constituent of nearly all the rocks except the carbonates.

A silica ion consists of a silicon ion in the center of a tetrahedron, at the four corners or apices of which are oxygen ions, as illustrated in Fig. 7. A tetrahedron is a pyramid formed of four equilateral triangles, one of which is the base. The structure of silica is most readily conceived if one stacks up four billiard or golf balls—three as a base, with the fourth on top of and resting on the other three. The small open space in the center of the four balls would hold the silicon ion or atom, for the oxygen ions are between three and four times as large as the silicon ion.

Silicon thus has a 4- coordination with respect to oxygen, but each oxygen ion is bonded to two silicon ions, so that the chemical formula of silica is correctly stated, SiO_2. All silicate minerals, including quartz, are made up of these 4- coordinated ions or tetrahedrons of silica, joined together in various ways, such as rings, chains, etc. It is safe to say that these organizations of silica tetrahedrons provide the primary structure of a large part of the mineral kingdom. It is altered in various ways by the introduction of other ions, which results in mineral complexes, but it provides strength and form to many of these.

Most structural chemists apparently believe that the bond between the silicon ion and the oxygen ions is about 50 percent ionic and 50 percent valence. They know that the bond is not pure ionic, for in that case there would be a gap or space between the ions, or as it is described a discontinuity in the electron clouds surrounding each ion. However, X-ray photographs show that while there is no actual gap, there is a thinning of the electrons where the ions come closest. In a purely ionic bond, the silicon atom would have given up its four outermost electrons to the four oxygen ions, while in a valence bond it would share two electrons with each of the four oxygen ions. That would give the silicon ion a share in eight electrons, and each oxygen ion a share in seven electrons, in the outermost shells, respectively.

Without attempting to show the silica tetrahedron in three dimensions, Fig. 8 illustrates a diagrammatic sketch of the structure of quartz silica particles. It can readily be seen that the Si to O ratio varies with the size when considering very small particles such as colloidal particles, and only in a lattice of relatively large dimensions would the exact 1:2 ratio be achieved. This explains why silica, as a pozzolan, for example, is more ac-

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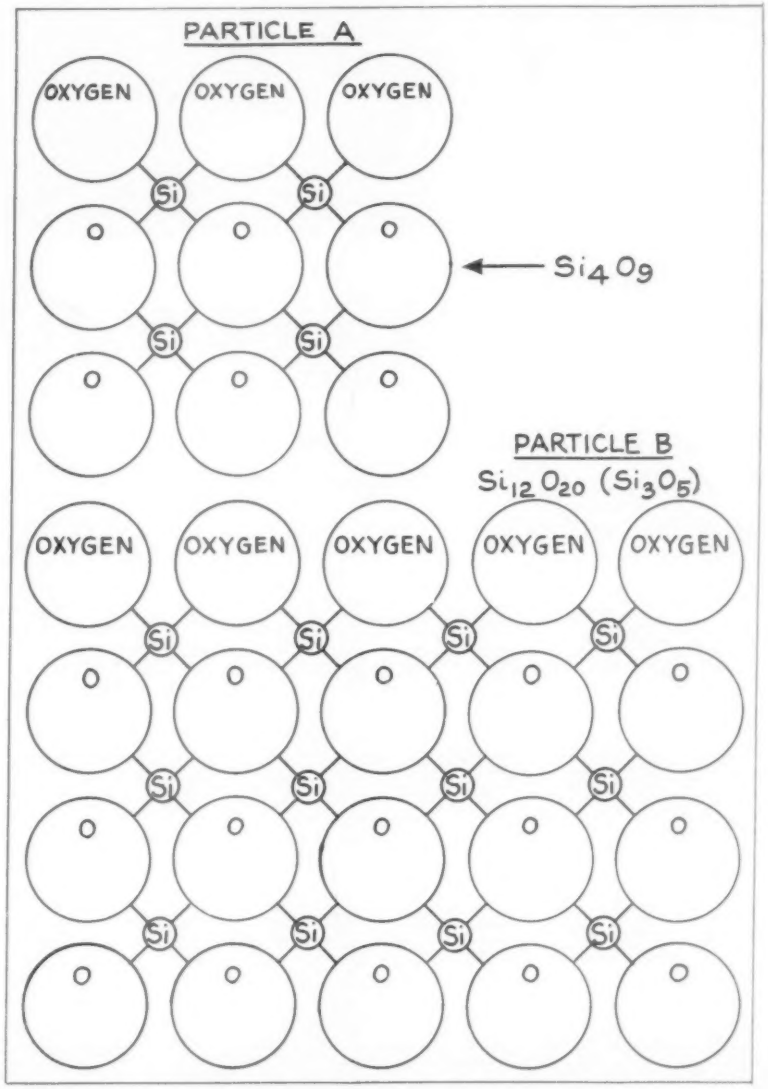
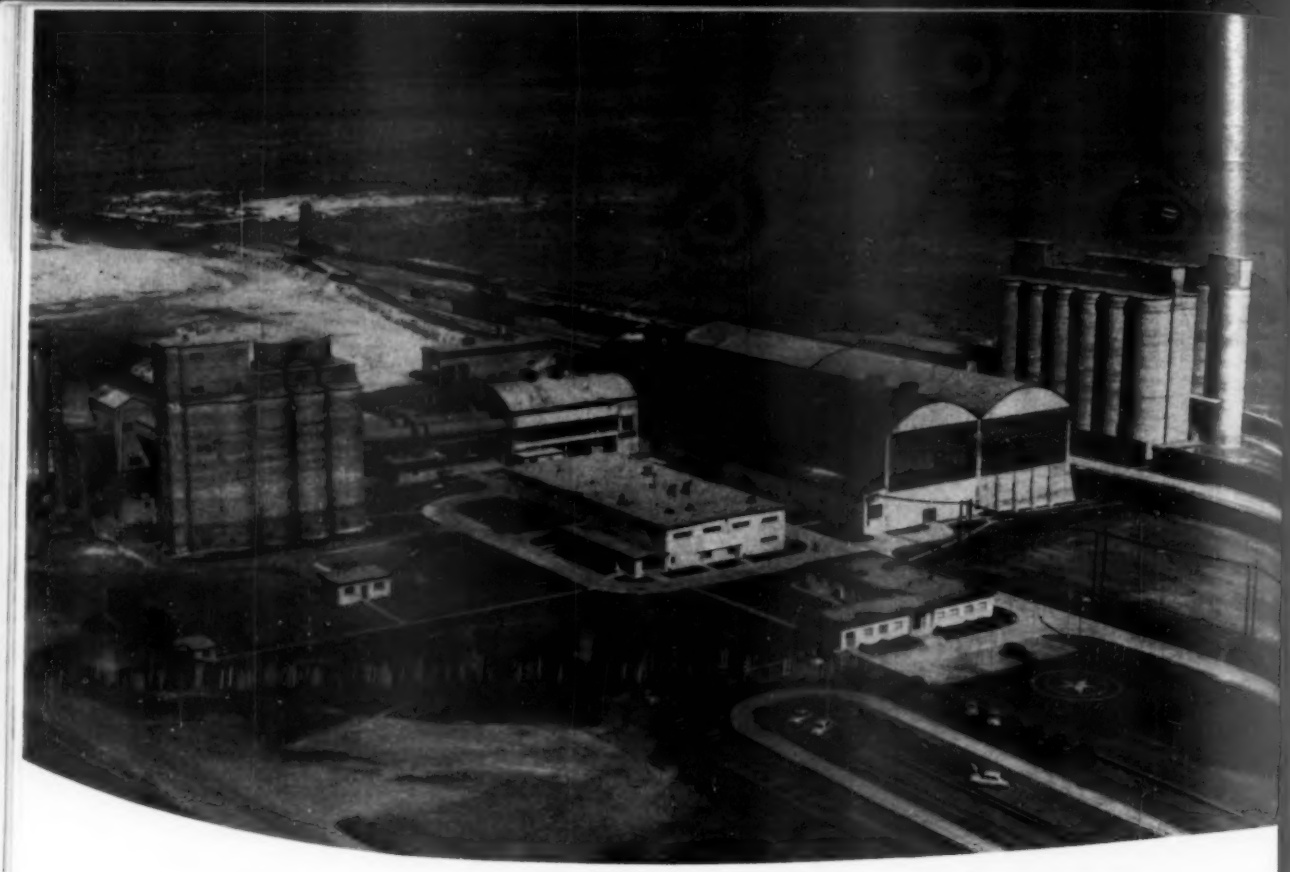


Fig. 8: Structure of quartz silica (shown in one dimension only)



LONE STAR'S NEW TEXAS PLANT

Mill at Maryneal, Texas, has gas-fired 10- x 340-ft. dry process kilns. Design follows pattern of Roanoke, Va., plant completed in 1951

By WALTER B. LENHART

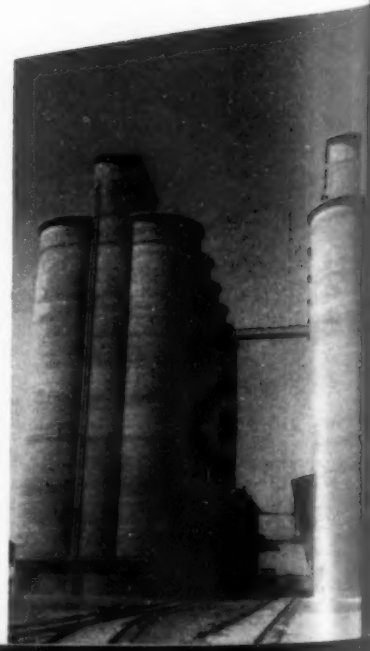
THE FIRST PLANT of Lone Star Cement Corp. was built at Dallas, Texas, some fifty-odd years ago and during this span of over half a century the company has operated some 16 portland cement plants located in the East, Southeast, the Deep South and Latin America. The 17th plant, and incidentally the westernmost, has just been placed in operation in the Lone Star state only 250 miles west of the company's first operation. The new plant is located at Maryneal, Texas, about 20 air miles southwest of Sweetwater and is on the Panhandle and Santa Fe railroad.

The construction of this portland cement manufacturing plant on the eastern fringe of the plains section of Texas marks another milestone in the gradual movement of population and industry to the Southwest.

The years 1951-1952 saw two new plants of this progressive company go into production: the Roanoke, Va., plant was described in the August, 1951, issue of ROCK PRODUCTS, and the one at Maryneal, Texas, is very similar. In addition to the new plants, older ones have been modernized and some enlarged so that today the Lone Star Cement Corp. has an annual capacity of 31,400,000 bbl. of portland cement. The company has a third new plant under construction in Brazil.

Plant Design

The Maryneal plant was designed in the New York offices of Lone Star Cement Corp. under the direction of Th. Avnsoe, former executive vice-president and now vice chairman of the board; E. Posselt, former vice-president in charge of engineering and purchasing, now consulting engineer; and Claiborne C. Van Zandt, former chief engineer, now vice-president in charge of engineering, in co-



operation with the engineering staffs of the various major equipment suppliers and contractors.

R. A. Hummel, former president of Lone Star Cement Corp., is now board chairman and H. A. Sawyer is president.

During the construction period at Maryneal, E. J. Van Reekum was project manager and R. R. McBride was construction superintendent. Mr. Van Reekum is now general superintendent of the Northern Division of Lone Star Cement Corp., with headquarters at Indianapolis, Ind. Mr. McBride remained at Maryneal and is now superintendent of the operation. W. H. Henson is assistant superintendent; Lee Dodge is chief chemist; Clyde Radney, general mill foreman; J. S. Callison, quarry and crushing plant foreman; William Sealey, packhouse foreman; Carl Dickerson, repair foreman; O. L. Bradford, chief electrician; A. C. Imhoff, plant engineer, formerly in the New York City offices and L. Arnold, chief clerk.

The regional offices of Lone Star are in Dallas, Texas. Bryan Oldham is vice-president in charge of the Texas Division. L. J. Wheeler, Dallas, is general superintendent of the Texas Division.

Construction work started on the Maryneal plant in October, 1950. The kilns were placed in operation in December, 1951, and the first shipments were made on January 21, 1952.

Walsh Construction Co., in conjunction with Gifford-Hill & Co. of Dallas, were prime contractors. The Macdonald Engineering Co. prepared the detail designs for the raw silos, cement silos and packhouse, and served as sub-contractor for all silo construction. Roberts & Schaefer Co. developed the concrete design of the main mill, kiln and storage buildings. Wallace Plumbing Co. of Dallas served as a sub-contractor in connection with much of the mechanical equipment, plumbing and piping. The office laboratory and service building designs were a modification of those prepared by the Austin Co. for the Roanoke plant. Fishbach & Moore, Inc., served as sub-contractor in connection with all of the electrical work.

The topography at Maryneal is in general quite similar to the vast range land of west Texas—almost perfectly flat and devoid of any appreciable amount of vegetation outside of range grasses.

Plant Layout

The two kilns are the longer leg of an L-shaped layout and in general the layout follows the pattern of the Roanoke plant, except that the office and quality control laboratory building is not within the two legs of the "L," but is set apart from the plant itself. Near the feed end of the kilns are the eleven blending silos. The clinker crushing, raw grinding and drying, and finish grinding mills with air separator, dust collectors, chain drags and related equipment are housed in a single building. The aerial view shown of the Maryneal plant will give a good idea of the arrangement of the main structures.

The crushing plant is located on the quarry floor. It is of reinforced concrete construction. Belt conveyors deliver the crushed limestone to the storage building which also has space for crushed clay, silica, sand, iron ore and clinker. The roof over the

Upper left: Aerial view of Lone Star's Maryneal, Texas, plant

Lower left: There are three rows of silos for finished cement, with six silos per row. Switching tracks divide the silo area into one row of bulk silos (right) and the other section for package or bulk silos. Packhouse is in the left background

Above: View of packhouse and silos showing car loading docks

Above right: General view of limestone quarry. Loading is done by a 4-cu. yd. electric shovel, with haulage by trucks fitted with 16-ton side-dump trailers. Tractor is clean-up unit

Right: Grinding mills as seen from firing floor near hot end of kilns. The two-compartment mill in the foreground is for finish grinding of clinker. In the background are raw grinding mills. Clinker crushing, raw grinding and drying, and finish grinding mills, with related equipment, are housed in a single building

storage area is of arched design. Paralleling and directly adjoining this building and under its own arched roof is the raw and finished grinding equipment previously referred to. The discharge end of the kilns and coolers are in one end of the mill building. The machine shop, foreman's office, service rooms, electrical shop, and storeroom are combined in a large, flat-roofed structure in the center of the plant. On the second floor of this 82- x 182-ft. building is a large meeting room used for safety meetings and assemblies. A kitchen with refrigerating equipment is provided.

Provisions have been made in the design for a doubling of the production facilities. The electric power system, shipping facilities, pipelines, conveyors and auxiliaries installed are for twice present plant capacity.

Like the new plant at Roanoke, Va., the Maryneal operation produces any kind of portland cement required, including Lone Star's Incor 24 hr. cement, air-entraining portland cements, modified and masonry cements. Natural gas is purchased from Lone Star Gas Co. and electricity is purchased from the Texas Electric Service Co.

Reinforced concrete of a very uniform color and texture has been used at Maryneal. Vibration-free structures result that are easy to keep clean and which require a minimum of paint and repair. Lightweight concrete block has been used extensively.

The two arched roofs are of monolithic reinforced concrete and were placed using sectional retractable forms that were shifted sidewise between successive pours. The roof concrete is about 6 in. thick with 75 ft. spans for each of the two barrel-roofed structures.

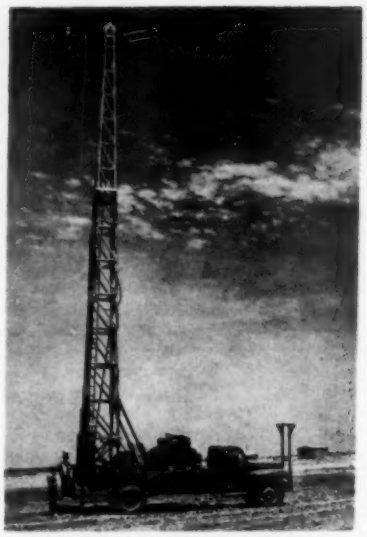
Johns-Manville Transite siding and roofing has been used extensively and a very striking and pleasing aspect is in the use of Corrulux, a translucent siding which forms some of the upper wall sections. This type of light-transmitting siding provides excellent daytime visibility within this large and unusually clean mill building. The first and upper floors of this mill building, as well as a mezzanine or operating deck around the grinding units, are of excellent textured reinforced concrete. All stairways, walkways, open bays, etc., are protected with steel hand rails; knee and toe boards are also of steel. Conveniently located are stairways, and in some instances ramps are used which are a convenience for moving repair parts, tools, welding outfits and other heavy equipment.

Firebrick are palletized with the loaded pallets stacked in neat piles under the enclosed end of the kiln which is adjacent to the hot end. A Towmotor lift truck is available for handling the pallets and other heavier items. A Hough Payloader is part of the housekeeping equipment. A 1¼-ton Sedgwick freight elevator, located between the two kilns and adjacent to the clinker end, is available for handling refractories to the kiln and for other items. Overhead cranes are strategically located throughout the plant. Two Otis passenger elevators are provided, one to reach the top of the blending silos, and one at the finish silos. Some 18 automatic dust collectors are spotted about the plant. Mobile debris disposal units and sweepers are used to keep the plant very clean. In the packhouse a Lamson vacuum cleaner system has been installed so that it too is kept dust free.

The office and control laboratory is an L-shaped building; it is air conditioned, well lighted and has ample space for the supervisory and clerical staffs and the engineering department. In the main office is a meeting room where all department heads meet with the superintendent several days each week for a round-table discussion on the operation of the plant.

The plant operates on a 24 hr. basis, 365 days of the year. The packhouse, quarry and crushing plant are on a 40-hr. week.

The area is not well supplied with water, which was one factor in the company's decision to use the dry process at this plant. Not only is fuel saved in the dry process but ball and liner wear in dry plants is low, and it was said that at the Roanoke operation, after almost eleven months of operation, raw mill ball wear has been so slight that it could hardly be measured.



Primary drilling in the quarry is handled by a rotary drill mounted on a truck. It drills a 4¼-in. hole, operating dry. The 55 ft. high drill can fold back over the haulage unit

Clay is delivered to the plant by rail. A car shake-out is used to facilitate unloading the railroad cars to a track hopper under which is an inclined apron feeder serving a scalper screen

Grate-type clinker cooler under one of the kilns. At the discharge end of the coolers are hammermill-type clinker breakers

Water

Water for the Maryneal operation comes from four wells and is stored in a 200,000 gal. primary storage tank. In addition, two tanks are on top of the raw blending silos, each holding 30,000 gal. of water. One is fresh water, and the other is circulating water. Cooling water is circulated at 350 g.p.m. Drinking and sanitary water runs about 10,000 to 15,000 gal. per day.

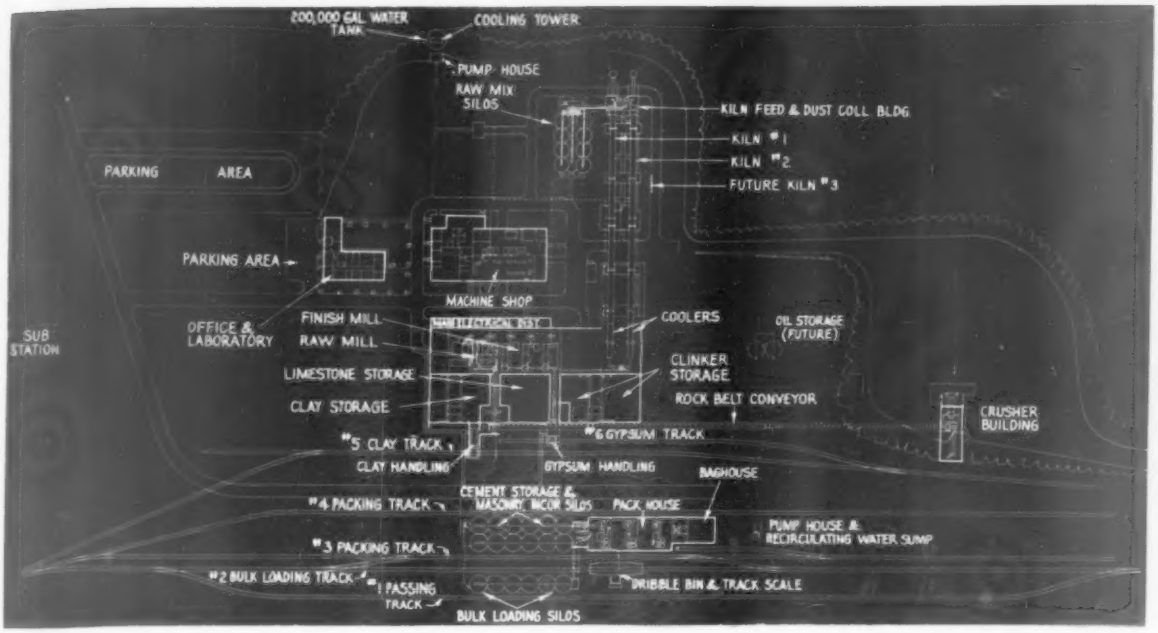
Raw Material

Principal raw materials used at Maryneal are a soft, relatively porous high calcium, low magnesium limestone that is quarried immediately adjacent to the plant; a relatively brittle clay that is shipped in from Sylvester, Texas—a distance of 35 miles; silica sand, and iron ore.

Quarry

The quarry has a face about 35 ft. high. The material is of uniform quality, low in phosphorus, sulfur and alkalies. Overburden ranges from 6 in. to 2 ft. and is removed by a Caterpillar RD-8 tractor and dozer which also acts as a clean-up unit on the quarry floor. The strippings are soil; no brush or trees occur, just range grasses.

Primary drilling is by a Joy model 225 rotary drill mounted on a Ford truck. The 55 ft. high drill can fold



General plan of Lone Star's Maryneal, Texas, plant

back over the haulage unit. It drills a 4¼-in. hole, operating dry. As the limestone is a soft material, drilling does not present unusual problems. The stone tends to break blocky. A Jaeger rubber-tired air compressor supplies air for secondary drilling. Due to the porous nature (and softness) of the rock the water content even in the semi-arid climate runs from 4 to 8 percent (average 5½ percent). The rock tends to dust easily. The same Joy drill is used at Sylvester to drill the clay deposits, but since a few blast holes there suffice for several months the rotary drill rig is rarely moved to the clay deposit.

Loading is by a 4-cu. yd. Bucyrus-Erie 100-B electric shovel, with haulage by three Mack trucks fitted with 16-ton Easton side-dump trailers. The clay at Sylvester is loaded by a 1½-cu. yd. Marion diesel dragline and is hauled to the plant by rail.

Crushing Plant

The crushing plant is built on the quarry floor, the trucks dumping to a 72-in. x 21-ft. 6-in. Pioneer feeder over a 7260 Dixie hammermill. Hanging vertically just ahead of the throat of the hammermill are heavy chains to contain any throw-back from the hammermill. The Easton bodies are dumped by a hook and permanently mounted unloading hoist. Trucks are dumped while still under cover. Over the primary section of the crushing plant is a 20-ton Whitney electric hoist.

Metal Detector

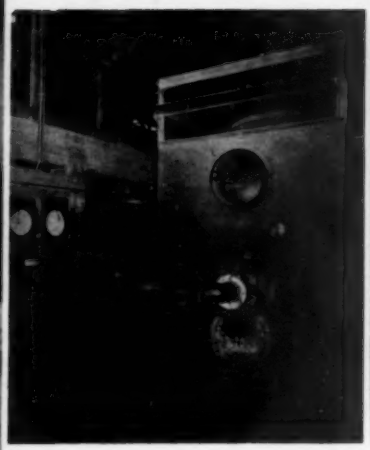
The primary hammermill discharges to a 36-in. inclined belt conveyor on 89 ft. centers. Over one section is an Eriez metal detector, which is an important device. A rectangular coil surrounds the belt conveyor and activates an electronic control. It will detect any metal object, magnetic or non-magnetic, that passes through it on the belt. The unit's effectiveness can be demonstrated by placing a copper wire or belt on the belt conveyor, and at the instant the material passes through the loop detector, the conveyor will stop. The unit will detect such items as shovel teeth—which are usually of non-magnetic manganese steel. When the belt conveyor stops, a horn sounds so the primary crusher operator can stop the feeder. There is ample bin space to take care of any lag so the belt cannot stall from tail-end overloading. Once the belt stops the metallic object must be removed, after which the operator starts the units again. There is no difficulty in finding the metallic object for it is exactly under the coil. Mounted on a post nearby are the electrical units that control this operation.

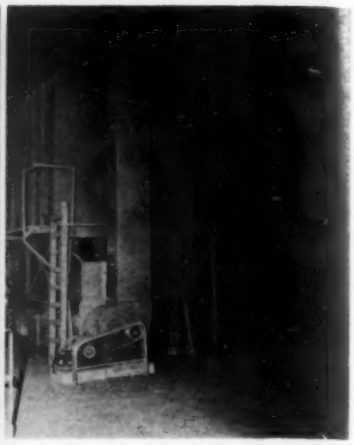
Diesel-electric locomotive spots bulk cement cars under a small bin mounted over track scales. Dribble gates are used to bring weights up to desired figure

A second belt conveyor, also 36 in. wide, but on 50 ft. centers, follows the above; it feeds a 6- x 12-ft. single-deck Allis-Chalmers Ripl-Flo vibrating screen, the oversize from this falling to an HM-05 Bulldog hammermill secondary crusher. The fines from the vibrating screen and the secondary hammermill join and are carried to storage.

Another feature of this crushing plant is the use of dust collectors; at Maryneal, a Sly dust collector having six hoppered-bottom sections picks up the dust from all the crushing plant operations. The collecting cones discharge to a screw conveyor that feeds a Fuller-Kinyon pump. The F-K pump unit operates as required and pumps dust to a storage tank in the storage building. The dust collected amounts roughly to 6 percent of the total limestone sent to storage.

The secondary hammermill





Left: Feed end of kilns. Blending silos (there are 11 silos) are at the left. Center: Gas-fired furnaces supply hot air for drying material in the air separators in the raw grinding circuit. No hot air is passed through the ball mills. Note the control panel at left. Right: One of the dust collectors in the clinker grinding circuit

unloads to conveyor No. 3, a 30-in. wide belt on 469 ft. centers, which in turn feeds belt conveyor No. 3-A, which is 196 ft. between centers. This belt is unloaded by a tripper at the storage bins. The conveyors are of Chain Belt manufacture, and Goodyear and Republic belts are used.

Clay is delivered by rail to the plant. The hoppered-bottom cars unload to a track hopper under which is an inclined apron feeder serving a scalper screen ahead of a 24- x 40-in. Armourweld (Pennsylvania) single-roll crusher. The screen is in open circuit with the crusher. Crushed clay is carried by drag-chain conveyor and bucket elevator to storage.

Storage Building

Storage capacities are: clay, 12,300 tons; limestone, 10,500 tons; iron ore, 500 tons; sand, 380 tons and clinker, 25,000 bbl. The storage building is 75 ft. wide and 340 ft. long. The building is spanned by two overhead traveling Bedford cranes, each of which has a 3-cu. yd. Blaw-Knox clamshell bucket. These rehandle the various materials stored (including clinker) to the feed bins as required.

Arranged at right angles to the main storage bins are five 325-ton feed bins for the raw side, and three similar bins on the finish side. Five raw feed bins hold limestone (2), clay, sand and iron ore. Clinker and gypsum bins and a bin for limestone that is used when making masonry cement are located on the finish side. Under the feed bins are the automatic proportioning feeders.

Five 24-in. type WS Merrick Feedoweights are used for proportioning the limestone, clay, sand and iron ore to the Compeb mills. The five are arranged in the shape of a "T." Sand and iron ore are fed from the feeders that form the short legs; clay and limestone feeders (two for the latter, located nearest the grinding mill) form the long leg.

Drag-chain conveyors are used to a considerable degree for intraplant transportation. These and the bucket elevator chains were supplied by Kensington Steel Co. The drag chains are all totally enclosed. They operate noiselessly, are economical on power and maintenance and are kept dust-free by vent pipes to dust collectors. Drag chains handle clinker, raw feed to the ball mills and other materials.

Raw Grinding

The five Merrick Feedoweights accurately proportion the raw materials. They discharge to a common drag conveyor serving a bucket elevator. The bucket elevator unloads to a chain drag serving two small hoppered surge bins. Under each raw feed bin is a small Chain Belt apron feeder (24 in. x 4 ft.) that in turn serves the bucket elevators ahead of the 16-ft. Sturtevant separators. The five proportioning devices make the first blend of the raw mix. The arrangement is such that adequate proportioning of the pre-ground raw mix is accomplished with the tonnage feed rate to each ball mill controlled at the apron feeder. Recording ammeters are connected to the bucket elevator serving the separators and guide the operator in the adjustment of the rate of mill feed. A circulating load of about 500 percent is maintained.

The raw material is fed directly to the air separators. All the material is minus ⅝ in. The separators are supplied hot air from furnaces burning natural gas. Air Devices, Inc., air heater furnaces are mounted on the same floor as the ball mill and use natural gas for fuel.

Each air separator is in closed circuit with a ball mill. The finished product is pumped by a 9-in. type A, F-K pump to the blending silos. The tailings from the separators return to their respective ball mills and the mill output goes back to the separator. Air for the pump is obtained from a 125-hp., C-200 Fuller compressor.

This system of feeding the raw material directly to the separators and supplying heated air for drying the material in the separator was developed by company engineers, and the Maryneal and Roanoke plants are possibly the first to use this system with ball mills for grinding. The performance exceeds expectations. No hot air is passed through the ball mills—all the drying is in the separator.

The gases leaving the separator pass to a 35-ft. long, 18,000-c.f.m. Northern Blower dust collector with the fan driven by a 50-hp. motor.

The separators, piping, conveyors and bucket elevators are all insulated to prevent heat loss and to prevent condensation. The insulating material also prevents radiation to the room and makes working conditions very pleasant. The insulating material specifications called for spun glass or its equivalent, and mineral wool fiber with asbestos fiber combined as a mineral block. The system also utilizes the heat of grinding within the mill which assists drying. The raw feed material contains a maximum of 8 percent moisture, with an average of 5½ percent; the ball mill discharge contains less than ½ percent moisture.

The heat delivered to the separator is adjusted automatically to take care of moisture changes in the raw feed. The inlet gas temperature is between 400 to 850 deg. F. and the exit temperature is kept between 180 to 200 deg. F. The volume of hot gases drawn through each of the air

Left: Cone crusher for crushing clinker. A dust collector vents the crusher as well as the elevating and screening equipment. Center: One of the hammermills in the crushing plant. Right: Exit gases from the kilns pass through dust collectors before being discharged through venturi-type stacks. All dust is returned to the feed system

separators is about 15,000 c.f.m. Every part of each grinding system is connected to a Norblo unit, making the grinding department dust-free. A control panel is mounted near the natural gas furnace, and on this are Foxboro, Brown and Wheelco recording and indicating thermometers.

Two identical and completely separate raw grinding units are provided. These are 9½- x 15-ft. single-compartment Allis-Chalmers ball mills, each driven by a 700-hp. synchronous motor. Each operates in closed circuit with a 16-ft. Sturtevant separator which is powered by a 100-hp. motor and driven through a Falk reduction unit. The fineness of the finished raw grind is held at 92-94 percent minus 200 mesh. The mills operate at 19.2 r.p.m. and are charged with 90,000 lb. of 3½- to ¾-in. forged steel balls. One mill is lined with Lorain liners, the second with spiral liners.

Each grinding unit, which comprises a ball mill, air separator and Norblo collector, produces an equivalent of approximately 120 bbl. per hr. The actual power input at each ball mill is about 500 kw.

The fuel required for drying automatically varies with the moisture content of the feed and is controlled by the temperature of the moisture-laden gases leaving the air separator.

All of the grinding mill motors are equipped with inching controls which permit the mills to be turned slowly for inspection or spotting purposes or for positioning the mills for the tightening of liner bolts.

Blending

For blending and storage of the raw materials there are eleven 22- x 85-ft. concrete silos arranged in three rows—four silos are on each side and three in the middle. Each has a net capacity of 3000 bbl. The total capacity is sufficient for a week's operation.

In a manner similar to Roanoke practice, the incoming material is pumped to a Fuller alleviator which is vented to a Sly dust collector. Dust is returned to the circuit and screw conveyors distribute to the required silos.

Under each row of silos are parallel sets of screw conveyors for blending and for part of the inter-silo transportation system. The raw grind in each silo is fed through a variable speed 16- x 27-in. Fuller rotary valve. Each screw conveyor under the silos serves a separate bucket elevator and the material is put back into any of the silos through distribution screws. The system is so designed that raw mix for any one type of cement is stored in silos at any one time, and storage is ample so that grinding of any one type of mix can go ahead for several days before the previous batch has been depleted from the silos.

Also similar to the Roanoke installation, the bucket elevators for the high lift are in two sections. Heavy-duty, single-strand chains are used for the bucket line with gravity type take-ups. Tail shafts are Stellited and the bearings are of manganese steel. The kiln feed elevators are also split so that the lower elevator can feed directly to the 150-bbl. kiln feed bin, or the material re-elevated to the top of the silos for reblending. The design of the elevator installation is based on Lone Star's operating experience that it is more economical to operate split-type elevators for long lifts, than it is to use a single lift. An Otis passenger elevator connects the working floors.

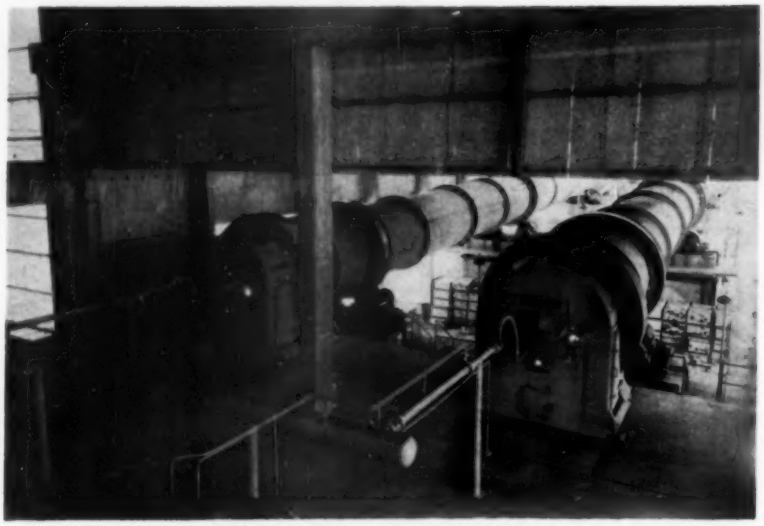
The rate of kiln feed is based on the use of a relatively shallow head tank in which a feed screw operates. This screw is synchronized with the kiln speed. The head tank in which the screw operates is kept overflowing at all times so that a constant head of raw mix is on the screw. Simultaneously any dust from the Buell dust collectors ahead of the Prat-Daniel fans is conveyed back to the kiln feed elevator.

The screw conveyor in the weir box at the top of the elevator feeds a spout that serves a short feed screw that delivers to the kiln. This feed screw unloads close to the kiln lining and on the up-running side, so that incoming feed is not picked up by the exhaust gases. It is a feature of dry kiln feeding that Lone Star has used for many years. This method eliminates the splash that results from the use of a spout, and insures a uniform depth of material in the kiln at all speeds of the kiln.

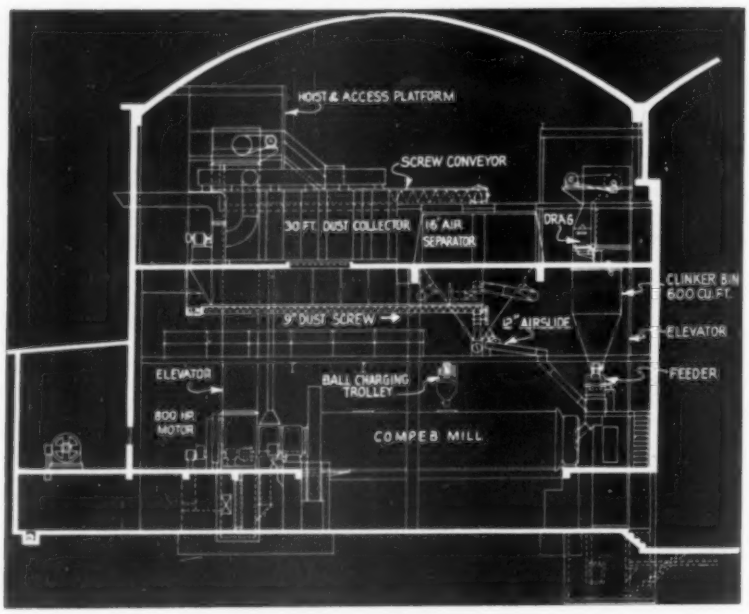
Kilns

There are two 10- x 340-ft. kilns placed on a slope of $\frac{1}{8}$ in. per ft. The hot zone is lined with basic brick; most of the remainder is 40 percent alumina. The lining is 6 in. thick. Power required to drive the kilns at 50 r.p.h. is actually 25 hp., but each kiln is powered by a 75/100 hp. Allis-Chalmers d-c variable speed, 400/1200 r.p.m. motor. The main drive gear encircling the kiln is of single helical Falk design with matched pinions which are driven by Falk herringbone speed reducers. There is no vibration at any speed and the gears and kiln run very quietly. Each kiln is equipped with an auxiliary gasoline engine for use in case of power failure. The kilns have a nominal output of 2000 bbl. per day each. Temperature in the burning zone is around 2700 deg. F. The kilns ride on five supports with water-cooled bear-

Conveyor belt at left delivers crushed clinker to the drag conveyors serving clinker storage. In the center is an air separator and at right is the air cooling and dust collecting unit for one of the two-compartment mills. Open bays in the foreground are for future installation of additional separators and grinding units



Firing end of the two natural gas fired kilns



Cross section of finish mill

ings and with the trunnions running in water. The firing hoods and dust chambers are insulated with A. P. Green cast insulating material. Speeds range from 28 to 84 r.p.h.

About 75 percent of the kiln's length is in the open. On the kiln floor and in a spacious and spotlessly clean room is a control panel for each kiln. Each panel includes a Brown kiln exhaust and dust collector temperature recorder; a Hays kiln and exhaust draft recording gauge and a Brown kiln speed recorder. Also included are damper regulators, ammeters, kiln speed controls, overgrate cooler pressure controls for secondary air temperatures, etc. Natural gas is provided through a 3-in. pipe with 2-in. burner tip enclosed within a 15-in. manifold. Pressure is 5 p.s.i. at the tips.

Exit gases from the kilns are cooled from around 1300 deg. F. to 700 deg. F. by admission of free air. All dust is returned to the feed system. Each of the two Prat-Daniel 100-ft. venturi-type Thermix stacks has a size 155 Thermix fan driven by a 200-hp. motor.

Clinker Cooling

The hot clinker falls to Fuller grate-type coolers. The air in excess of combustion requirements passes through Multiclone dust collectors and to atmosphere. At the discharge end of the clinker coolers are hammermill-type clinker breakers developed by Lone Star. This breaker not only reduces the clinker in size but throws most of the hot broken product back onto the cooler grate, thus exposing hotter core pieces to additional grate cooling. The clinker is cooled to about 150 deg. F. The hammermill is designed to reduce the plus 1½-in. clinker. The unit uses 7 hp. Hammers are expected to last for at least a year without attention. Clinker passing the grate, clinker breaker, and Multiclone dust collector is carried to a single-deck Aero-Vibe vibrating screen by a drag chain and bucket elevator. Oversize from the screen is recrushed to minus ⅝ in. in a No. 330 Hydrocone crusher. The screen is in closed circuit with the crusher. The undersize from the screen is taken to the storage area. A Sly dust collector vents the crushing, elevating and screening equipment in this department.

The kilns produce approximately 2000 bbl. per day each and exit gas temperature runs about 1300 deg. F. The gases must be blended with cold air to limit the temperature to 650 deg. F. before entering the Buell collectors and exhaust fans. The kilns operate best in a speed range between 40 and 50 r.p.h.

Clinker Grinding

The clinker grinding system involves the use of three 8- x 32-ft. two-compartment Allis-Chalmers Compeb mills operating in closed circuit with individual 16-ft. Sturte-

vant air separators. Each mill is driven by an 800-hp. Allis-Chalmers synchronous motor. The mills are charged with 130,000 lb. of 3½- to ⅝-in. forged grinding balls; Lorain steel liners are used. Each separator is powered by a 100-hp. motor through a Falk reduction unit. Each grinding unit is provided with a 30-ft. Northern Blower dust collector which keeps the grinding system under slight negative pressure. The Norblo dust collectors draw about 10,000 c.f.m. of air through each air separator which cools the cement.

Three feed bins are used for clinker and gypsum, though one bin is used for limestone when making masonry cement. Material from the bins flows to three totally enclosed Merrick Feedoweights similar to those on the raw side. The Feedoweights deliver to a drag conveyor serving a bucket elevator, which in turn delivers to a drag ahead of 60-bbl. steel hoppers serving each of the three mills. The mill bins are kept small to minimize segregation. An 18-in. x 4-ft. Chain Belt apron feeder controls the feed to each of the Compeb mills. The circulating load is nominally around 300 percent. If the load deviates from this percentage the recording ammeter will respond and adjustments are then made manually by the operator.

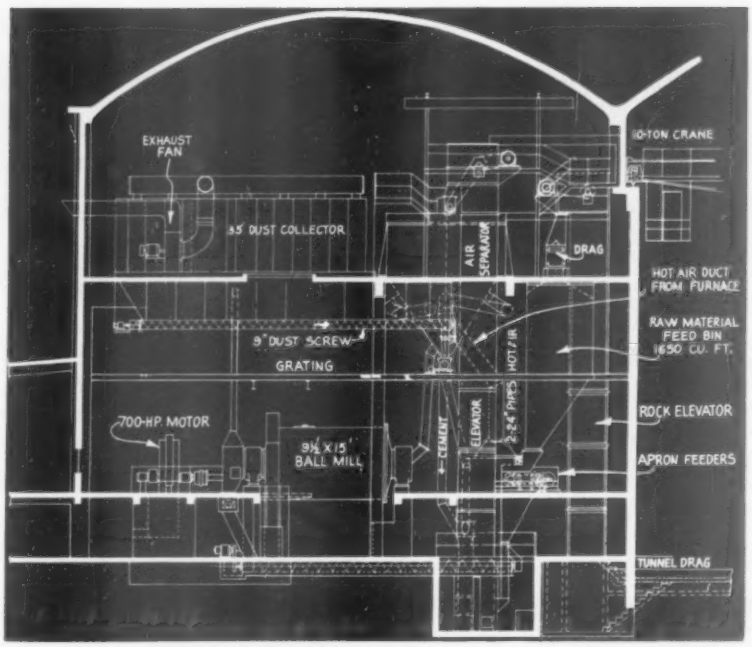
In the separator, cold air is drawn into the inner cone and the hot air is removed from the space between the inner and outer cones. This is quite effective and cools the rejects as well as the finished cement, and in the process lowers the room temperature in the mill building. Normally, it was pointed out, the discharge temperature of ground cement is between 230 to 270 deg. F., but with the dust collector installation this is lowered to 140 to 160 deg. F. Additional cooling is possible enroute to the packhouse. It will be noted that the cement cooling system and the raw drying system are alike, except that in the one case hot air is supplied for drying and in the other cold air is supplied for cooling. The separators are provided with 60 auxiliary blades instead of 48 as is usually the case. Rejects or tailings from the air separators are returned to the grinding mill by Fuller-Huron Airslides.

The Compeb mills have a capacity of 100 to 115 bbl. per hr. each when grinding Type I cement. The final ground products are transported by screw conveyor to an 8-in. F-K pump for delivery to the finish storage silos. A Fuller C-250 air compressor supplies the air. The pump and compressor use a 100- and a 150-hp. motor, respectively.

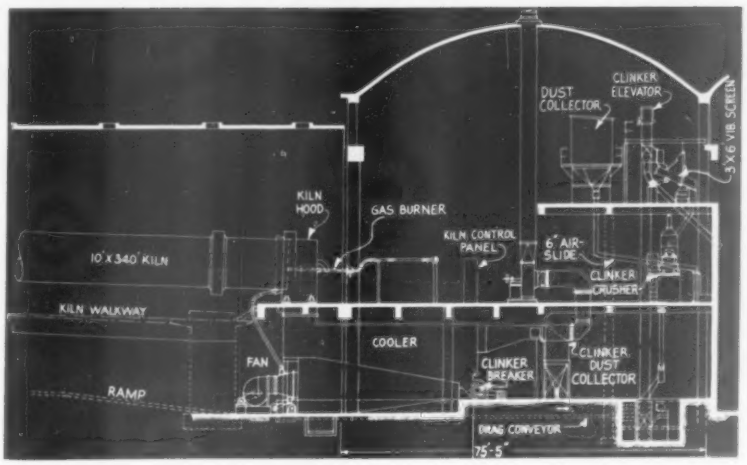
Each clinker mill unit produces Type I cement at a rate of about 105 bbl. per hr. and each mill motor draws about 620 kw.

Cement Storage

There are three rows of silos for finished cement, with six silos to the

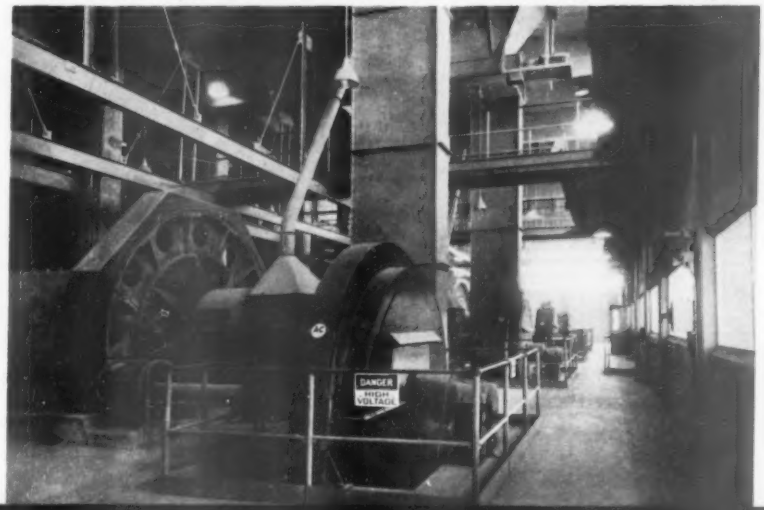


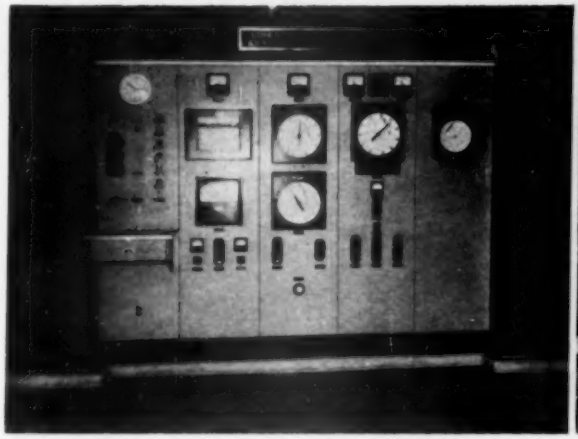
Raw mill cross section

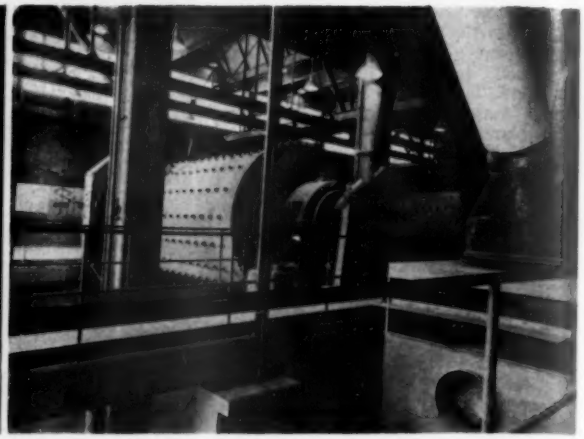


Cross section through burning platform

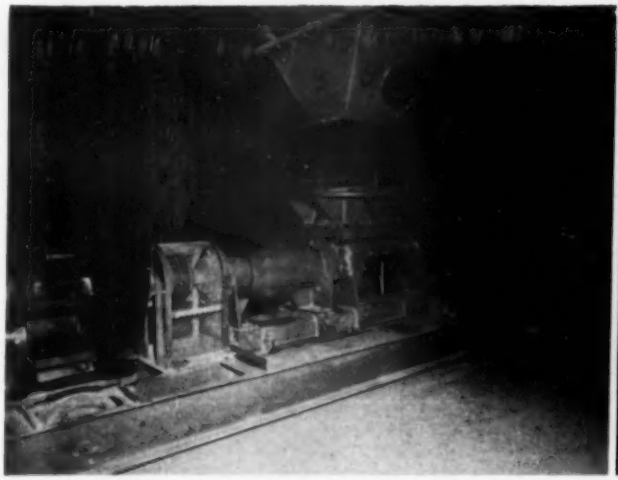
Below: Clinker grinding system includes three 8- x 32-ft. compartment mills (left foreground) operating in closed circuit with individual air separators. Each mill is driven by an 800-hp. synchronous motor (foreground). Other finish and raw mill motors can be seen in the background

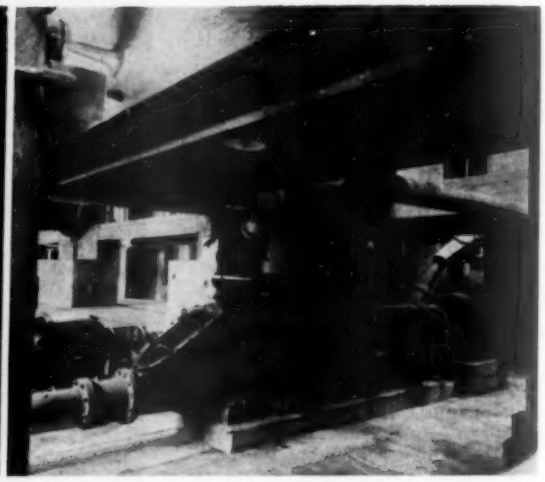




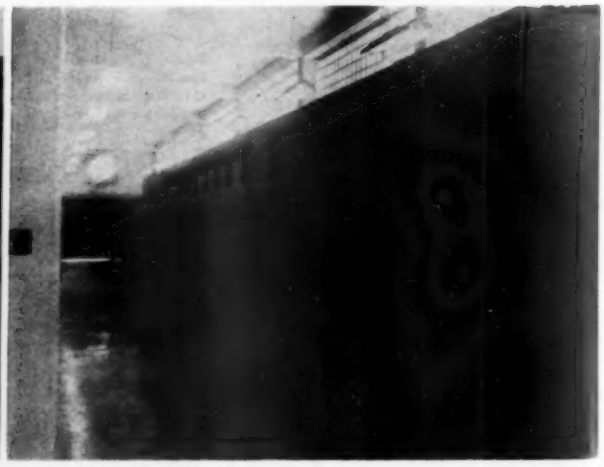


Left: One of the kiln control panels. Right: One of the 9½- x 15-ft. single-compartment ball mills for raw grinding. Part of a drying furnace can be seen at right

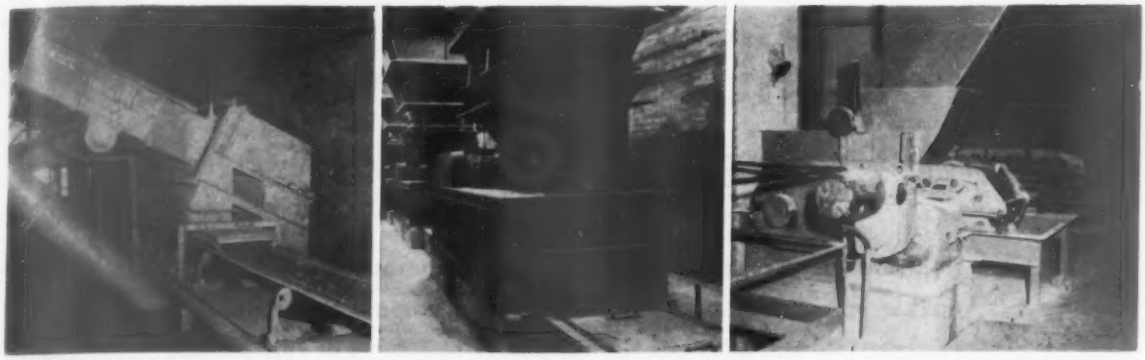




Left: Under each row of silos at the finish end are portable cement pumps for transport of the cement. Right: One of the large pumps used to transport finished cement from the air separators to the finished cement silos



Two views of main control room for grinding units and related equipment



Left: Single-deck vibrating screens ahead of the clinker crushers. The plus fraction goes to the crushers and the fines discharge to the belt conveyor. Center: Automatic proportioning feeders feed the raw materials to the mills; the one in the foreground is for clay, the two in the background for limestone. Right: Apron feeders under small hoppers that are ahead of the raw mills. Similar units receive clinker and gypsum for the finish mills

row. Switching tracks divide the silo area into one row of six bulk silos and the other section of 12 package or bulk silos. The silos are 26 x 110 ft. high; the interstices are used only for ventilation purposes.

Under each row of silos at the finish end are portable Fuller-Kinyon pumps similar to those used in the Birmingham, Dallas and Roanoke packhouses. At Maryneal, three Fuller blowers, each equipped with air filters which are mounted in a dust-free and dust-tight room adjacent to the packhouse, supply air to the F-K pumps. An Otis passenger elevator is provided to serve the silos.

Cars for bulk shipment are gravity-loaded from the bulk silos. A General Electric diesel-electric switch engine spots cars under a small steel bin mounted over track scales. Dribble gates here are used to bring the weights up to the desired figure. The dribble bins are loaded by an F-K pump to an alleviator and a vent dust collector.

Packhouse

The packhouse is similiar in design to the Birmingham (Ala.) operation which was described in the September, 1948, issue of ROCK PRODUCTS. There are four 4-tube St. Regis packers. Bagged cement falls to woven wire belts. Three of the belts are reversible so that loading can go ahead on either track paralleling the packhouse. At the fourth packer are two shorter similar endless belts, back-to-back, so that the one machine can serve both tracks.

One of the packing stations is set aside for masonry cement, and as there is no interconnecting equipment, contamination cannot take place. One station is set aside for Incor, either with or without air-entraining admixture, and the two remaining stations are for the various other types of standard portland cement. A rather unique circulating system is employed which gives a constant head of material over the packers, the purpose of which is to keep weights constant. The circulating tanks permit a quick

Natural gas is fed through this burner assembly on one of the kilns

switchover to other types of cement without contamination. Cement is pumped from the silos to an alleviator (with a Sly dust collector on its vent) and into the 150-bbl. tank at each packing station. Bin-Dicators are used on these tanks. Fuller-Huron feeders regulate the flow from the tank to the screw conveyor. The packhouse is kept spotlessly clean.

Electrical

A 4360-volt distribution system supplies all the General Electric unit substations, the quarry shovels, and all motors 300 hp. and larger. The synchronous motors are 80 percent P.F. machines and the system power factor is kept near unity. All motors 300 hp. and larger are wound for 4000/2300 volts so they can be transferred to any of the company's plants that operate at 2300 volts. The large motors and the main switchboard were supplied by Allis-Chalmers. All motors 250 hp. and smaller and all gearmotors were supplied by General Electric.

The main switchboard, all synchronous motor starters, motor-generator sets, raw and finish unit substation, raw and finish grinding multi-unit control centers, and d-c distribution equipment are placed in a well-lighted substation lean-to adjacent to the mill building. In the room are two motor-generator sets for the d-c current used on the kiln drives. Both are Allis-Chalmers 250-kw. d-c generators directly connected to 380-hp. A-C synchronous motors.

A General Electric 4160/480 volt unit substation is installed in each department of the plant to handle the 440 volt load. The main substation and, where possible, other substations are supplied with filtered air to eliminate the costly maintenance which results from dust and moisture. All 440 volt starters are of Allen-Bradley manufacture assembled into multi-unit control centers by the Metropolitan Electric Manufacturing Co. All main circuit breakers are rated at 150,000 kv.-a. interrupting capacity and 1200 amp. The 4000-volt motor starters are all equipped with General Electric limit amp. fuses and Allis-Chalmers air break contactors.

Industrial Accidents

THE NATIONAL SAFETY COUNCIL recently announced the publication of its 1952 edition of "Accident Facts," a statistical annual of occupational, motor vehicle, transportation, home, farm and school accidents. According to the book, the total cost in dollars of occupational accidents in 1951 reached the staggering total of $2,650,000,000.

Twenty-one pages of the 96-page book are devoted exclusively to occupational accidents and list the commonest sources of injury, parts of the body most frequently injured, and present other information relating to off-the-job problems, women in industry and many other subjects.

Single copies of the book may be obtained from the National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill., at $0.75 each. Prices are reduced for quantity purchases.

Turbulent Diffusion with Gas and Pulverized Coal Burners

Relationship between flame length or combustion rate and nozzle velocity and diameter studied. Comparison of pulverized coal flames with gas flames points to effects of turbulence

By KENJIRO SAJI*

STUDY OF THE RELATIONSHIP between flame length or combustion rate of gas or pulverized coal, and the corresponding nozzle velocity and diameter is of considerable interest. Kikuji Goto, chief engineer of Nihon Cement Co. in Japan, has investigated the Reynolds number for the pulverized coal burner of the cement rotary kiln and found that it is associated closely with the mixing of air and fuels. On the other hand, Dr. Sakae Yagi, Tokyo University, has pursued the theory of turbulent diffusion and applied it to the combustion of the gas burner.[1]

On the basis of the author's study of gas flames or experiments and observation of pulverized coal burning in an experimental apparatus and in practical cement rotary kilns, the outline of some problems of turbulent diffusion for gas and pulverized coal burners will be discussed here.

Turbulent Diffusion and Velocity Distribution Pattern in Jet Flow

The importance of turbulence in achieving rapid combustion of gas, liquid and solid fuels has been recognized. This has been evident in the many practical devices and operations.

In the following short summary, some theoretical studies of the mixing in a jet of fluid discharging from a circular nozzle into a quiet surrounding fluid will be described.

The simple case of two-dimensional turbulent flow with the assumption that the main streams run parallel with the x axis and their velocity, u, is a function of y, then the frictional force in the flow, τ, is expressed in the following equation:

$$\tau=\mu\frac{du}{dy}-\rho\,\overline{u'v'} \qquad (1)$$

where μ is the coefficient of viscosity,
ρ is the fluid density,
u',v' are velocity fluctuations in x and y components, respectively.

The first term of this function is viscous stress and the second term is the so-called Reynolds stress. Except in the neighborhood of a solid surface the viscous stress is negligibly small as compared with the latter, so

$$\tau=-\rho\,\overline{u'v'} \qquad (2)$$

The mass transfer perpendicular to the main flow is due to this Reynolds stress.

According to Prandtl's momentum-transportation theory

$$\tau=-\rho\,\overline{u'v'}=\rho l^2\left|\frac{du}{dy}\right|\frac{du}{dy} \qquad (3)$$

where l is the so-called Prandtl's mixing-length containing the statistical relationship in the mixing or relationship of u' with v'. The value of l can be calculated by means of measured values of τ and $\frac{du}{dy}$. In the case of laminar flow from Eq. 1 we have $\tau=\mu\frac{du}{dy}=\rho\nu\frac{du}{dy}$ and therefore $\nu=\frac{\tau}{\rho\frac{du}{dy}}$

which is called kinematic viscosity.

In the case of turbulent flow from Eq. 3

$$\frac{\tau}{\rho\left|\frac{du}{dy}\right|}=l^2\frac{du}{dy}\equiv\xi \qquad (4)$$

and this ξ should be termed "turbulent kinematic viscosity" with the same dimension as ν and molecular diffusion coefficient, namely (cm.²/sec.). According to Yagi's theory of turbulent diffusion, ξ is assumed to be equal to the turbulent diffusion coefficient.

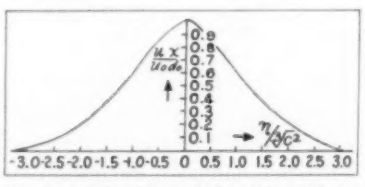


Fig. 1: Relationships calculated by Tollmien

According to Tollmien,[2] the equation of the shearing stress in a jet from a circular nozzle is as follows:

$$\tau=\rho\,\overline{u'v'}+\rho\frac{\partial}{\partial x}\int_{\infty}^{y}u^2dy \qquad (5)$$

in which the second term represents the shearing stress due to the stream flux outside y. Assuming that $l=cx$ in Eq. 3, in which the constant c was obtained by experiment, and putting $y/x=\eta$, he calculated the relation between $\eta/\sqrt[3]{c^2}$ and $\frac{ux}{u_0d_0}$ (Fig. 1 and Table I). Here u_0 and d_0 are nozzle velocity and diameter, respectively. In the theoretical calculations $u_{max}(x)=\frac{u_0d_0}{x}$, where $u_{max}(x)$ is the axial and maximum velocity at distance x from nozzle mouth along the jet axis, and therefore $\frac{ux}{u_0d_0}=\frac{u}{u_{max}(x)}$. When x was measured from a point that was properly upstream from the nozzle, the results of his calculations coincided with the experimental values obtained by the aeronautical research laboratory in Göttingen, for example, $d_0=137$ mm. and $x=1260$ mm. measured from a point 260 mm. upstream from the nozzle. In the same measurements in Göttingen the following results were obtained:

$$l=0.0158x=0.0364d \qquad (6)$$

where d=the diameter of the jet flow at x. Yagi, furthermore, calculated the values of ξ/u_0d_0 against $\eta/\sqrt[3]{c^2}$ (Fig. 2 and Table I) and showed that the maximum value of turbulent diffusion was in the conical surface that is about $\eta=0.07$ and the mean value over all conical surfaces in jet ξ was about $2\times10^{-3}\,u_0d_0$.

However, since Tollmien's mathematical analysis was not applicable to the part of flow nearer than $x=8\,d_0$, Kuethe[3] made calculations specifically for this region and obtained more accurate results of the velocity distribution pattern (Fig. 3) in which Tollmien's analysis was true of the C region. But it must be noted that all this is the case of an isothermal jet issuing into the same medium.

*Nihon Cement Co., Ltd., Nishitama Plant, Japan.

$\sqrt[3]{C^2}$	$\frac{u_x}{u_o d_o} = \frac{u}{u_{max(x)}}$	$\varepsilon / u_o d_o$
0.0	1.	0
0.0625	0.995	0.88×10^{-3}
0.125	0.977	1.23
0.250	0.941	1.69
0.500	0.843	2.18
0.625	0.789	2.33
0.75	0.727	2.38
1.00	0.606	2.41
1.25	0.487	2.28
1.50	0.376	2.04
1.75	0.283	1.68
2.00	0.198	1.51
2.25	0.130	1.21
2.50	0.077	0.91
2.75	0.039	0.63
3.00	0.014	0.03
$\sqrt[3]{C^2}$ = 0.063 TO 0.07 (BY EXPERIMENTS).		

Table I. Theoretical calculations by Tollmien and Yagi

Turbulent Diffusion Flame of Gas

According to the study of gas burning by Yagi, if a flame in cylindrical form is assumed to have air and fuel mixed by molecular or turbulent diffusion, which means that the chemical reaction rate of combustion is assumed to be very large as compared with the mixing rate, the following equation of material balance will be established in the ideal case:

$$-\frac{\pi d^2}{4}\frac{dc}{dx}u = \pi d\,\frac{D+\xi}{\delta}\,\Delta c \qquad (7)$$

where d is the diameter of flame in centimeters;
c is the concentration of fuel in flame;
D,ξ are the molecular and turbulent diffusion constants in cm.²/sec.;
δ is the diffusion layer length in cm.;
u is the velocity of gas flame in cm./sec., and
x is distance from the burner to the nozzle.

The above equation can be integrated by using the average values of u, D and ξ at the boundary condition of ordinary atmospheric combustion: $\Delta c = c$, $c = c_1$ at $x = 0$

$$\frac{c}{c_1} = e^{-\frac{4(D+\xi)}{ud\delta}x} = e^{-KZ} \qquad (8)$$

$$K = 4(D+\xi)/d\delta \qquad (9)$$

where K represents the mean coefficient of combustion rate (sec.$^{-1}$) and Z is the burning time (sec.). For instance, if the flame length is defined as $c/c_1 = 0.1$, the following equation of the flame length L is obtained by putting $c/c_1 = 0.1$ and $x = L$ in Eq. 8:

$$\frac{L}{d} = \left(\frac{2.3}{4}\right)\left(\frac{\delta}{d}\right)\left(\frac{ud}{D+\xi}\right) \qquad (10)$$

and since D is usually smaller than 1 cm.²/sec., then D is negligible compared with ξ for a fully turbulent flame. And by Yagi's measurements for various burner nozzle orifices, e.g., 1, 2, 2.5, 3, 5, 7 and 10 mm. for gas of 3000 k. cal./mm.³ without primary air, L/d_o becomes

$$\frac{L}{d_o} = 60 \sim 70 \qquad (11)$$

Besides this, turbulent diffusion flames of various gaseous fuels were described by Hawthorne and Weddell of Massachusetts Institute of Technology in their theses in 1939 and 1941, and Hottel and others at M.I.T. published a summary of these in the Third Symposium on Combustion, Flame and Explosion Phenomena held in 1948 in the United States.[4]

It is generally recognized from these results that the length of fully turbulent diffused gas flame is proportional to the nozzle diameter and, although not strictly correct, the proportionality constant depends upon the properties of the nozzle fluid and its combustion gas.

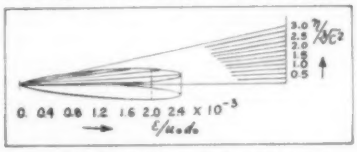


Fig. 2: Relationships calculated by Yagi

By the author's following considerations of turbulent diffusion and combustion jet, flame lengths given above can be calculated theoretically. Details are intended to be published at the Fourth Symposium on Combustion, Flame and Explosion Phenomena at Massachusetts Institute of Technology in September of this year.

1) Assuming that $l = \delta$ (12)
2) For an isothermal jet $\xi = 2 \times 10^{-3}\, u_o d_o$, but in the combustion jet this should be multiplied by the factors of temperature variation and the composition of gas while passing from the nozzle mouth to the tip of the flame, that is,

$$\xi = 2 \times 10^{-3} (u_o d_o)_n \left(\frac{\rho \text{ fuel \& prim. air}}{\rho \text{ flame gas \& resid. fuel}}\right)_n^{\frac{1}{2}} \left(\frac{T_f}{T_n}\right)^{\frac{2}{3}} \left(\frac{T_n}{273}\right) \qquad (13)$$

where T_f and T_n are respectively the absolute temperatures of flame gas and nozzle fluid and the subscript n represents the normal state.

3) For the ideal combustion process adapted in the equation $\frac{c}{c_1} = e^{-KZ}$, probably as turbulent gas flame, the mean content of unburned fuel in the flame is obtained as a constant value of about 0.39, namely, 39 percent, provided that flame length is defined as from ignition to $c/c_1 = 0.1$.

In this case from Eq. 6, 10, 12 and 13 the theoretical formula for turbulent gas flame is obtained as the following:

$$\frac{L}{d_o} = (10.45)\left(\frac{\rho \text{ flame gas \& resid. fuel}}{\rho \text{ fuel \& prim. air}}\right)_n^{\frac{1}{2}} (1+M)^{-1}\,(0.61\,V_o + 0.39)\,(T_f/T_n)^{\frac{1}{3}} \qquad (14)$$

where M is mixing ratio, $\frac{\text{primary air (nm}^3)}{\text{Fuel gas (nm}^3)}$ and V_o is theoretical combustion gas volume without excess air (nm^3/nm^3 fuel).

This formula agrees with many experimental results of Yagi and Hottel and others and shows that the important factors governing flame length are mainly d_o, $\left(\frac{\rho \text{ flame gas \& resid. fuel}}{\rho \text{ fuel \& prim. air}}\right)_n$,

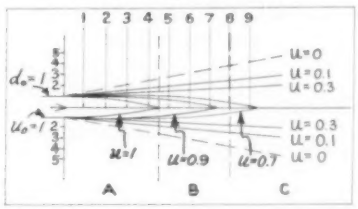


Fig. 3: Velocity distribution pattern for isothermal jet issuing into the same medium

V_o and M. Of these factors the second and third depend upon the properties of gaseous fuels, therefore d_o and M are of utmost importance for practical equipment and for combustion. ξ contains the term of $u_o d_o$, so that if $u_o d_o^2$, namely the amount of nozzle fluid, is constant, the smaller d_o is the more the factor ξ and the combustion rate increases.

The spread angle of the combustion jet is about half that of the isothermal jet. This can also be explained theoretically. If L/d_o can be calculated, we can obtain the coefficient of combustion rate K, because both the mean

FIG.	$u_o d_o$ cm³/sec	Tn °K	AMOUNT OF COAL CHARGED Wc g/min	PRIM. AIR − WEIGHT / PULV. COAL − WEIGHT M	FLAME LENGTH L(cm) = L/d_o
4	5070	68+273	96	2.56	64
5	6850	49+273	186	1.9	77
6	6470	49+273	137	2.44	77

PROPERTIES OF COAL USED:
H.V. = 6860 Kcal/Kg., V.M. = 34.12%, ASH = 14.72%, MOIS. = 1.97%
AS FINENESS AS RESIDUE ON THE NO. 170 SIEVE IS ABOUT 11% IN WEIGHT.
FOR EXAMPLE, M IN THE PRACTICAL ROTARY KILN = 2.4 TO 3.5

Table II. Data on flame experiments

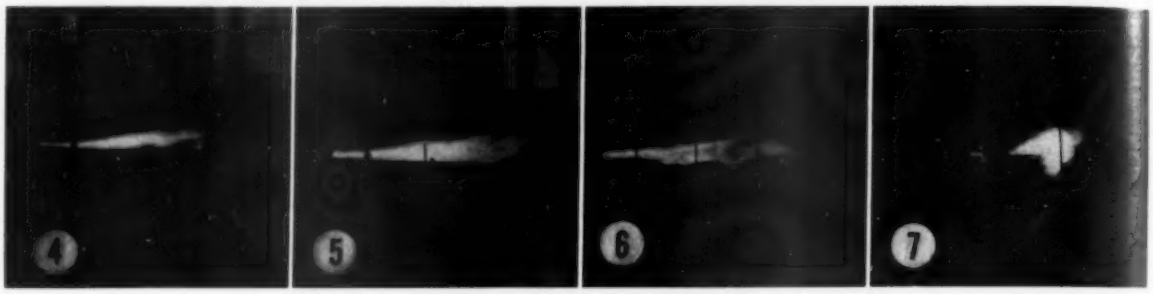


Fig. 4, 5, 6 and 7: Turbulent diffusion flame tests of pulverized coal

diameter of turbulent flame and the diffusion layer length δ are obtained as functions of d_0. Now, therefore, it is possible to calculate the distribution of flame temperature by using the value of K and equations of the rate of combustion and heat transfer. And since we know that K is proportional to u_0/d_0, when $u_0 d_0^2$, or the amount of discharged nozzle fluid, is constant, K is inversely proportional to d_0^3. This is very important.

Turbulent Diffusion Flame of Pulverized Coal

Although it is not strictly correct to consider turbulent flame of pulverized coal in a similar way as that of gas, the previously mentioned results of gas burning serve as a good reference for our practical use.

In fact, from the results of the direct gas analyses of the industrial flame in the cement rotary kiln by Hans Gygi in Zürich and also from our observations of the flame, or the state of the sintering zone, in our cement rotary kiln, it can be assumed that

$$\frac{L}{d_0} = 60 \sim 70 \qquad (15)$$

provided that c/c_1 at the tip of the flame $= 0.1$.

From the author's research on burning of the same powdered coal as used in his experimental apparatus, in which the burner is 10 mm. I.D. and ignition is by means of the special firing-cylinder which has many small nozzles, jetting air-gas flames for horizontal turbulent flame in free air is

$$\frac{L}{d_0} = 65 \sim 75 \text{ (by photographs)} \qquad (16)$$

The experiments were conducted under the conditions shown in Table II.

From these facts it can be seen that d_0 is one of the most important controlling factors for pulverized coal combustion. An experimental and theoretical formula for the combustion rate or the flame length in pulverized coal burners and various fineness of particles is being developed. However, to the question, how can a rapid rate of combustion be achieved, particularly for low-grade or incombustible coal, the answer is to use a suitably small sized burner to make the flow more turbulent in order to enlarge the value of K. It may, however, be necessary and desirable to use a high pressure fan.

Of course, the importance of fine grinding cannot be over emphasized.

The results above, in fact, seem to coincide with the practical results obtained by many cement engineers in Europe[5] and Japan during World War II. Ultimately it may also be desirable to have a special burner with some kind of branched nozzle pipe. This has been tried in Germany.[6]

In conclusion, the author wishes to express his gratitude to Prof. S. Yagi for his invaluable advice, and acknowledgment is made of the assistance given by J. Hosoi, director of Nihon (formerly Asano) Cement Co. Central Research Laboratory, and by Y. Kasakawa, manager of the Nishitama plant.

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Cement Industry Safety Record

THE PORTLAND CEMENT ASSOCIATION, during the past 36 years, has maintained a safety program which has reduced the number of occupational injuries at cement plants by 87 percent. For the past several years, cement has been named by the National Safety Council as one of the safest of the heavy industries. In 1951 only communications and electrical equipment made a better showing than cement (among the 40 industries reporting to the council). This is particularly outstanding in view of the fact that cement production involves the hazardous operations of quarrying, mining and blasting, the use of high voltage electric current, intense heat and some of the world's largest moving machinery.

In 1951, member plants established the lowest accident rate in the 36 years of the association's accident prevention program. The number of disabling injuries per million man-hours worked was 4.22, which was 13 percent below the 1950 rate, 50 percent below the rate of seven years ago and fractionally lower than the previous best record of 4.26, established in 1939. Although three times as much portland cement is being produced today as seven years ago, the injury frequency and severity rates are only one-half that of seven years ago.

According to advance information from national agencies studying accident experience, the industrial injury rates, as a whole, were higher in 1951, due primarily to increased employment and production and longer working hours. However, it was the seventh successive year of progress in preventing accidents in member company cement mills and quarries. The severity rate of 1.84 days lost per thousand man-hours worked was the second lowest on record and was 3 percent below the 1950 severity rate.

Special commendation was given to employes of 95 quarries and mines, among the 127 in membership, for not sustaining a single lost-time injury during 1951. Some of these operations have records of upwards of 20 years without a disabling injury to any worker.

The cement industry's success in reducing occupational injuries results from a carefully planned and humane approach to the problem of safety with whole-hearted support by the P.C.A. membership. Revision of work methods through engineering studies, provision of mechanical safeguards where needed, persistent safety education and training, and safety competitions have all played a part in the success of the P.C.A. accident prevention program.

Buys Gravel Plant

THOMAS CONSTRUCTION CO., Ashland, Neb., has purchased the Central Sand & Gravel Co. from Richard T. Carter who had operated the plant for the past several years. The transaction included all of the equipment and lease of the land.

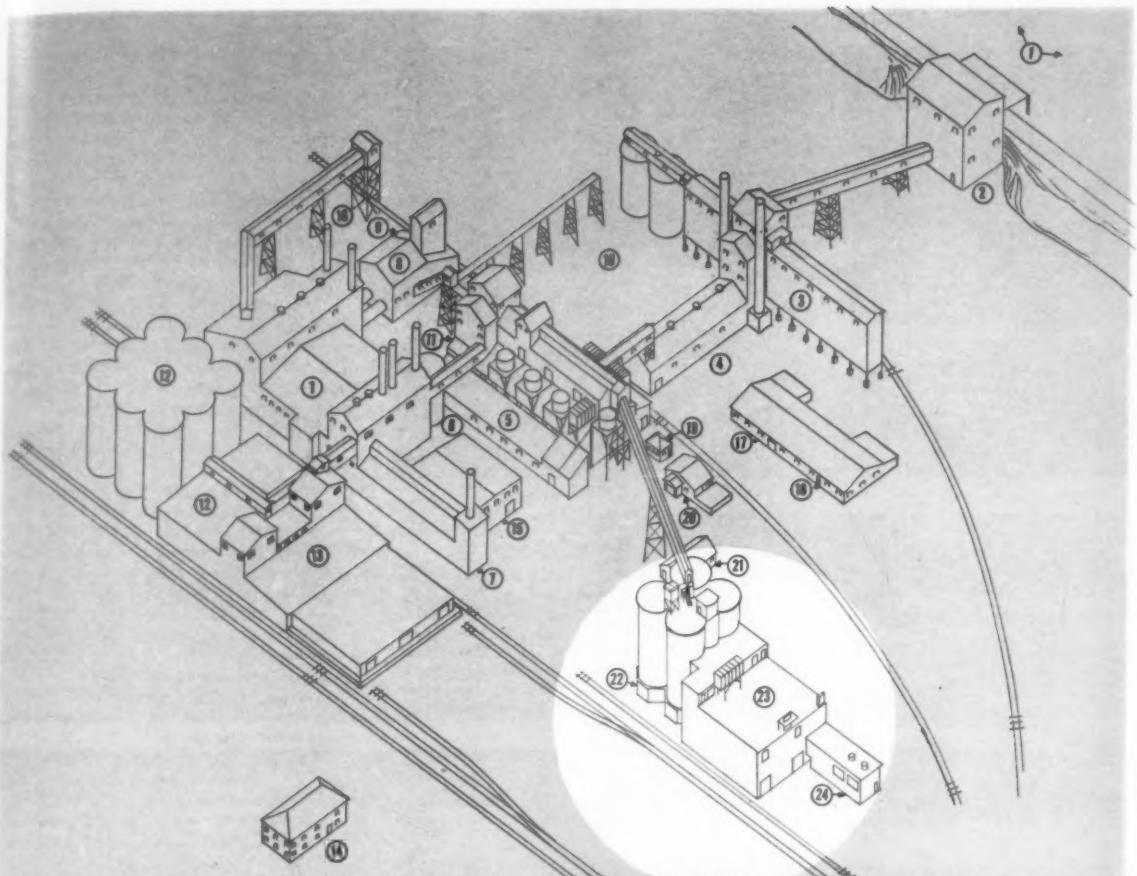


Fig. 1: Layout of Ideal Cement Co.'s Trident, Mont., plant. Numbers refer to (1) quarry; (2) crusher plant; (3) raw material blending and storage; (4) dryer building; (5) raw mill; (6) kiln feed storage; (7) kiln building; (8) cooler building; (9) gypsum storage; (10) clinker storage; (11) finish mill; (12) cement storage; (13) packhouse; (14) office; (15) electrical substation; (16) coal storage and handling; (17) shops; (18) storeroom; (19) foreman's office; (20) oil house; (21) wash and change building; (22) plant No. 2 clinker storage; (23) plant No. 2 finish mill; (24) plant No. 2 substation

FINISH MILL GRINDING AT TRIDENT, MONT.

New unit increases capacity from existing plant of Ideal Cement Co. and is first step in building entirely new operation

By HAROLD LAMONT*

IN THE YEAR 1805-1806, Lewis and Clark were exploring the great northwest for the United States government in order that officials in Washington would have a better idea of the tremendous lands involved in the Louisiana Purchase. Cold weather was fast setting in over the land, making traveling in the rugged country almost impossible. Lewis and Clark, in looking for a spot to camp and spend the winter, selected a beautiful valley at the point where three rivers, now known as the Gallatin, Jefferson and Madison, unite to form the mighty Missouri. This beautiful valley is completely surrounded by mountains which protect it from the severe winter snows and storms, a fact which undoubtedly had a great influence in its being selected for their winter retreat.

In the summer of 1907 a group of Utah businessmen formed the Three Forks Portland Cement Co., selected O. B. Gilson as general manager, who still resides in Ogden, Utah, and started the construction of a cement plant on the same site chosen by Lewis and Clark for their winter retreat. Soon after its incorporation, Ideal Cement Co. purchased controlling interest, and the Three Forks Portland Cement Co. was formally dissolved in 1947.

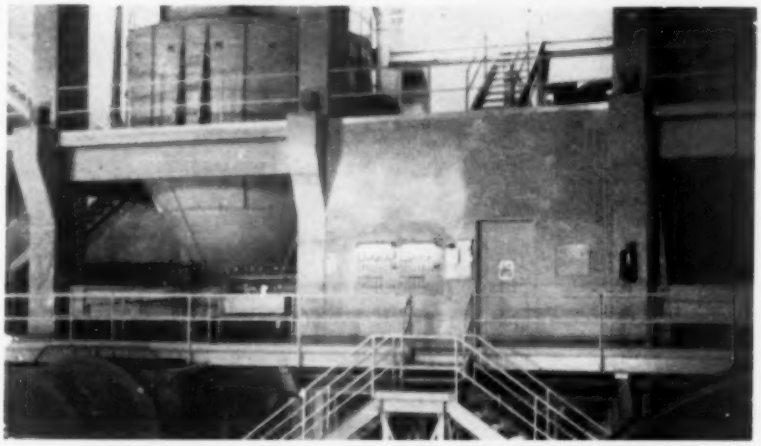
Under Ideal's management, plant improvements have been continuous and vast, such as the new kiln and grinding mill installation (described in ROCK PRODUCTS, August, 1949, page 140).

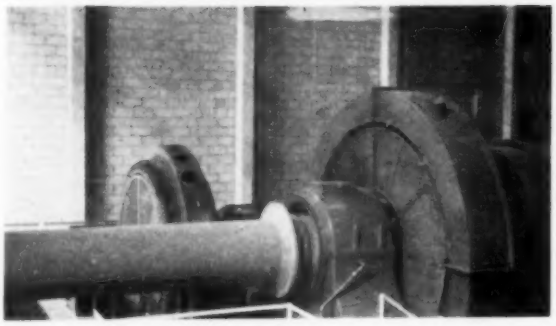
Construction was started on the first stage of an entirely new plant in 1950. This was felt desirable in order to take care of the cement demand in this area, to prevent interruption of the present production facilities, and to incorporate all the latest engineering features of modern design into a new cement plant.

The finish grinding department was selected as the first step in the new plant construction. A location was decided upon entirely away from the existing plant as shown by buildings 22-23-24 in the center foreground of Fig. 1. Clinker is being transported over to the new finish grinding mills by a long overhead inclined belt conveyor until the new kilns and raw mills are installed.

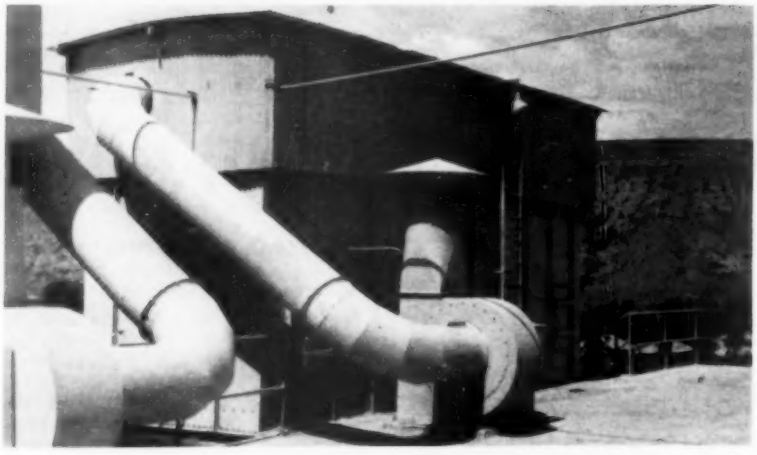
Cleanliness was one of the primary requirements in the design of the new finish mill room. This has been accomplished by the use of adequate dust collectors with suction lines to

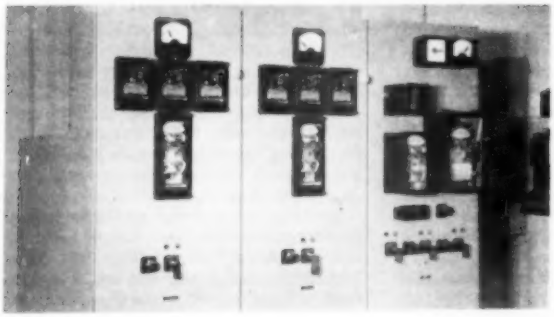
*Division superintendent, Rocky Mountain Div., Ideal Cement Co., Trident, Mont.





Above: Interior view of mill building showing air separators and control panel. Left: Archimedes screw used for transporting material from mill





Above: Dust collector on top of the mill, used for air-sweeping the mills and separators as well as for dust collection. Left: Electric power distribution switchboard

all dust points. The results have been very gratifying.

The general arrangement of the first section of the new plant, which is now in operation, is shown in elevation in Fig. 2. Clinker is brought over from Plant No. 1 on a belt conveyor and stored in one or more of the four clinker bins. Gypsum is stored in the interstice or star bin. With this arrangement, it is possible to store two kinds of clinker for each of the two finish mills. A Northern Blower dust collector located on top of the clinker and gypsum storage silos maintains a negative air pressure in the storage silos which results in a dustless material storage.

Clinker and gypsum are fed by gravity from storage through bin discharge gates onto Merrick Feedoweights, then onto 24-in. belt conveyors through feeder boxes into the 8- x 30-ft. Traylor finish mills. In order to feed these mills without dust, it was deemed advisable to install booster fans which pick up dust from feeders and belt conveyors discharging into the air separators, thus the system is used for dust collection as well as clinker cooling. The results have been very satisfactory, resulting in a dustless mill room and cool separator discharge.

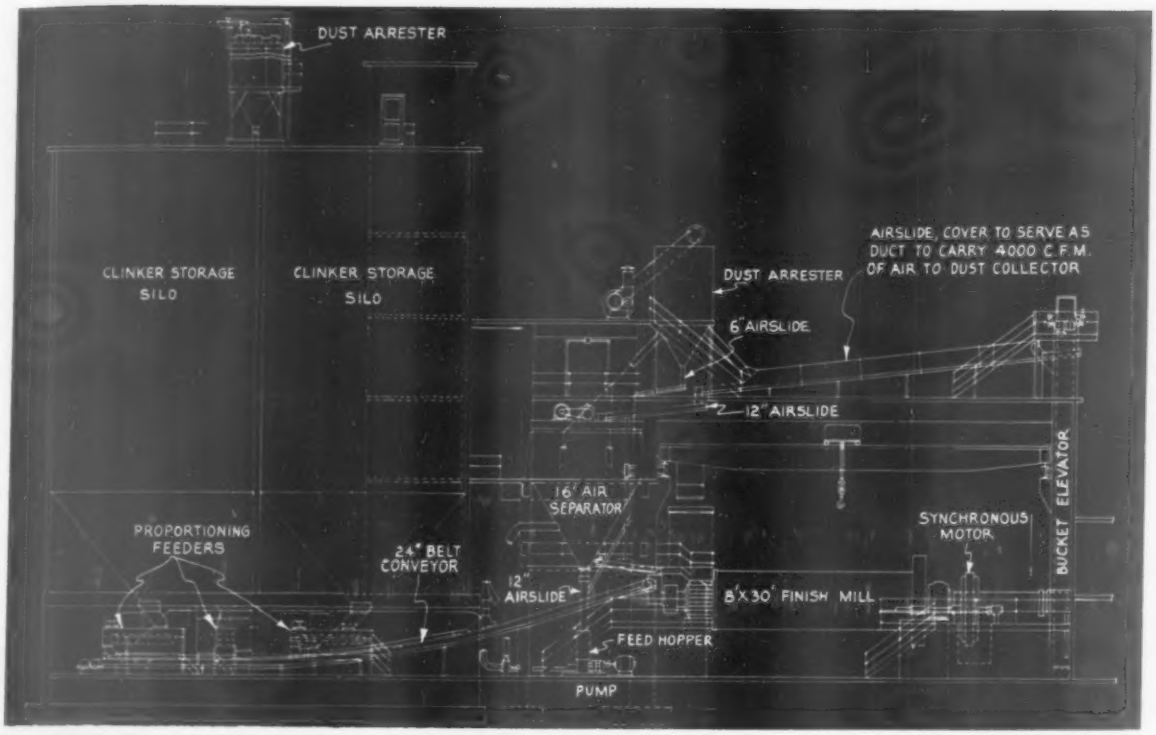
The 8- x 30-ft. Traylor finish mills are driven by General Electric Type TS, 800-hp., 180-r.p.m., 4160-volt synchronous motors. Full starting voltage of the mills is accomplished without the aid of clutches. Electric energy is supplied by the Montana Power Co.

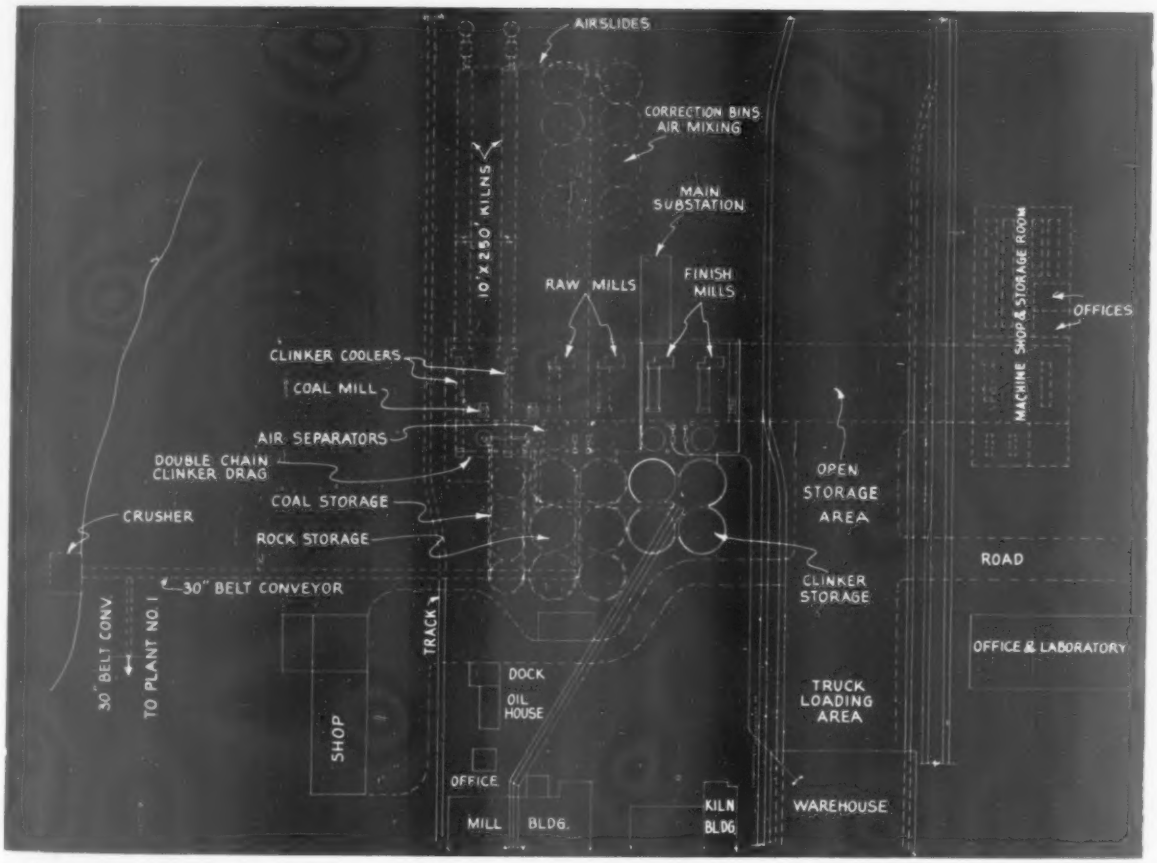
The mill product is conveyed by an Archimedes screw, the construction of which is very simple. It merely consists of a cylinder with screw flights on the inside and a screen on the discharge end for separating the tramp metal. The feed end is supported by means of a flexible connection by the mill bearing, the discharge end being carried by a tire and two supporting rolls.

The material is then conveyed vertically by a bucket elevator with concrete casing and is discharged onto a Fuller-Huron Airslide. Air for the latter is supplied by a No. 5E Buffalo fan. The Airslides, elevators, and Archimedes screws serve as ventilating ducts for cooling the mills with suction to Northern Blower dust collectors. Using conveyor housing for air ducts has eliminated long horizontal dust collector pipes which tend to plug due to material settling out. The material is then fed into 16-ft. Sturtevant air separators which also are air cooled by the Norblo dust collectors.

The rejects from the air separators are returned to the mills by Airslides. The fines are conveyed by Airslides to a Fuller-Kinyon 7-in. cement pump, then transported through a 7-in. pipeline to the storage silos. Air for the

(Continued on page 211)





Details of Trident plant No. 2. Top: Arrangement of finish mill section. Bottom: Plan of plant; dashed lines represent future installations

Ring Formation in Cement Kilns

Incomplete combustion primary cause of rings in rotary cement kilns. Secondary factors in ring formation include chemical composition of raw materials, humidity, fineness of grinding, volatile materials, combustion time, heat value of coal and excess air

By B. M. PEARSON*

PREVIOUS STUDIES made by F. Matouschek on the formation of rings in rotary cement kilns have been published.[1] This trouble is due to one single cause, namely, poor combustion conditions. As yet the problem must be treated empirically, for the most part. The method used is to give a well-founded and definite general demonstration of the problem, rather than to make a study-treatment involving formulas and equations which would perhaps be valuable for a specific kiln under well-defined conditions, but which would not be applicable to other kiln systems and for other raw materials.

Raw Materials

The chemical composition of the raw materials plays only a secondary role in the formation of rings in the cement kiln. Effects of certain chemicals are described here.

Iron oxide. The above statement at least holds good for raw materials whose Fe_2O_3 content remains within normal limits. If this content is too high, and if the temperature must be maintained to fire the material, there is a tendency to agglomerate into balls. Conditions then become favorable for the mass to stick to the refractory lining of the kiln and cause rings.

Aluminum oxide. This can no longer be considered the basis of sticking and the formation of rings, at least in all cases where the content changes slowly in such a way that there is no other disturbance in the kiln. A case can be cited in which it was necessary to work some banks of marl, between which were located clay deposits. It was necessary to increase by 20 percent the proportion of chalk which was used to correct the material. The content of Al_2O_3 was then on the average of about 0.8 percent higher to the detriment of the silica. Even in this case, which can be considered an extreme, there was no sticking.

Silica. Silica can exist in the raw material in the form of silicates (marl-clay), as silex or as quartz (sand). The mixtures which contain silicates are more easily fired than those which contain quartz. The hypothesis has been developed that the quartz separates from the rest of the material because of the speed of the gas in the furnace.

Some tests were conducted to ascertain if a separation took place in the coarsely ground calcareous materials. It was not possible, however, to confirm this hypothesis. (This is on the condition that the kiln dust is not removed from its circuit to be used otherwise, as fertilizer, for example.)

Even in the case where a part of the kiln dust picked up by the fan draft does not return into the circuit, there are only insignificant differences as is shown by the following analysis (average of five determinations).

Table I.

	Dust in part restored to the kiln	Dust entirely restored to the kiln
SiO_2	22.5 percent	22.7 percent
Al_2O_3	6.2 percent	6.3 percent
Fe_2O_3	2.0 percent	2.0 percent
CaO	67.1 percent	66.4 percent

The difference is slight. One accordingly cannot speak of a separation of the materials in the sense indicated. Taking into consideration the fact that the limestone and the quartz have about the same specific gravity, the example would appear to be applicable to materials which contain sand.

The sand and much of the dust influence principally the plasticity of the granules of the raw material. They are smaller, more friable, and dry more quickly. In the rotary kiln, there is a tendency to greater dust formation, the raw material "flows" more rapidly in the kiln and it can pass through the kiln in the form of waves. To remedy this, the burner is obliged to increase the coal feed and, if possible, the draft. But the flame is often compressed. Conditions become bad for good combustion and sometimes a kiln ring is formed within a space of a few hours.

In a Lepol kiln with a grate the same phenomenon of the disintegration of the granules is produced: these form an impervious bed on the grate. This causes a reduction of draft and, consequently, poor combustion.

Coal

The following factors can play a certain role: humidity, fineness of grinding, volatile materials, combustion time, calorific value of the coal and excess air.

Humidity. A. Baouman[2] has demonstrated that this factor is only a secondary one. It results in a heat loss of about 0.3 percent. This figure can reach 1.7 percent if all the moisture of the raw coal is blown into the kiln by an air-swept mill. P. O. Veh[3] found that a small quantity of moisture aids the combustion of coal.

If the coal from the storage silo is too moist, it remains agglomerated. This can be observed by the fall of "blue balls" in the material. This too

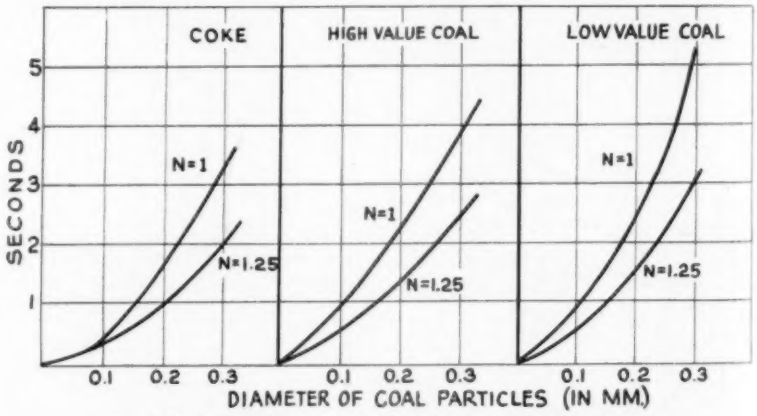


Fig. 1: Combustion times of various fuels; N=excess air (after Gumz)

*Consulting engineer, Saxonhurst, North Bank, Hassocks, Sussex, England.

Review of recent French technical studies, based on work of F. Matouschek, *Revue des Materiaux*, No. 427, pages 115-117.

constitutes a poor kiln operating condition.

Fineness of grinding. It is well known that the fineness of grinding considerably influences combustion. Fig. 1, which is taken from tests conducted by the German fuel technologist Gumz, illustrates this fact very clearly.

The time of combustion of coal dust has a certain technical importance for the cement industry. In general it can be said that the more finely ground coal is, the shorter becomes its combustion time, other conditions being assumed to remain unchanged. While Veh thinks that a coal should be ground finer the less volatile matter it contains, the data obtained by Gumz demonstrate that the ratio of the times of combustion of the coke, rich coal and lean coal are 1:1.2:1.5. Certain reservations have to be made, however. A mixture with gas coke has given a shorter flame than blast furnace coke. This different behavior is probably due to the structure of the coke. Tests have similarly shown that the combustion of the coke requires a high flame temperature.

Volatile matter. It has previously been stated that it is possible to burn combustibles having a variable content of volatile matter in the same kiln. After some tests, during the course of which the excess air and the production rate were varied, coals could be used whose volatile contents varied between 10 and 30 percent without causing ring formation. Observations made in other cement plants, that a coal whose content of volatile material exceeds a certain limit aids sticking, can be explained by the fact that the heat value of a coal diminishes if its gas content increases.

Calorific value (ashes). The heat value of the combustible has a big influence. For normal production and a sufficient excess of air, it has been possible to establish a certain relation between the calorific value of the coal and the formation of rings in the kiln. This relationship is shown in Fig. 2. This graph shows that the higher the calorific value of the fuel, the less tendency the kiln has of forming rings.

If the ring increases, then the combustion conditions become unfavorable because of the lack of air. However, the relation shown in Fig. 2 holds true only for the kiln examined. It is quite probable that other kilns would give another shape of curve, without, however, changing the characteristic of the ratio.

Excess air. The principal factor in obtaining good combustion is the excess air n. For reasons of fuel economy this is as low as possible. A great excess of air diminishes the combustion point of the fuel (according to Veh) i.e., the combustion gases are colder if n is high.

It is also known that if excess air is insufficient, a part of the coal can traverse kilns (almost 300 ft. long) without burning; the carbon is found

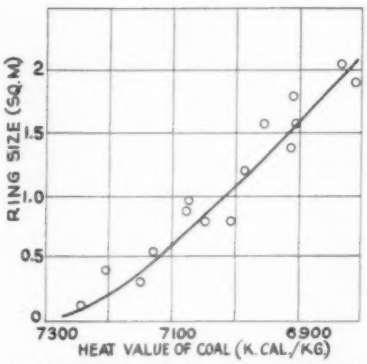


Fig. 2: Formation of rings as a function of the heat value of the coal

in the stack. If n is close to 1, the coal burns with a luminous flame and heat transfer by radiation increases.

In practice, it is necessary to fire the kiln to give an oxygen content of about 1.3 percent in the combustion gases, which requires 6 percent excess air. If combustion gives only CO, 70 percent of the calorific value is lost. Even a little CO in the combustion gas signifies inefficient burning. From the example given by A. Baouman, non-combustion must in all cases be avoided for economic burning. Calculation confirmed that even a large excess of air (for example $n=1.68$) is much less costly than a relatively small CO content.

A significant fact in support of the above statements is that either dry or wet process cement kilns, for which the raw material is preheated sufficiently and where the excess air is sufficient, never form rings in the kiln.

In kilns with chains, it is easy to correct for lack of air by opening the fan damper. The Lepol kiln is more of a problem, but the excess air must similarly be preserved by every means possible.

Summary

If the production limit of the kiln is exceeded, the fuel feed must be increased; the excess air obtainable no longer gives complete combustion. The firing zone becomes overloaded. If this condition lasts a certain time, a ring will be formed. A material poorly prepared, either in preheating or else in calcining, gives results similar to those of an overloaded kiln.

The increase in the degree of lime saturation of the clinker has the same effect as overloading. The observations of T. Yoshii[4] can be interpreted in this sense.

If the content of sand or dust exceeds a certain amount, the plasticity of the granules in the kiln changes. The material advances irregularly in the kiln; the firing zone becomes overloaded. This gives rise to the possibility of imperfect combustion and, as a consequence, the formation of a ring.

If a fuel low in heat value is being used, the temperature falls in the firing zone if production is maintained. The combustion is incomplete and gives rise to ring formation.

If the output as well as the heat value of the fuel remains normal, but for one reason or another there is insufficient excess air, combustion becomes incomplete and causes ring formation.

An indirect proof of these causes of the formation of rings is given by Barnard[5]. This investigator has indicated cases where control of combustion in rotary kilns was accomplished by automatic waste gas analyzers which determine the CO and oxygen contents and greatly help eliminate ring formation.

Conclusions

This study serves to show that the formation of rings in rotary cement kilns is due to several secondary causes. If one assumes the raw material is normal, these secondary causes can all be traced back to the primary cause of incomplete combustion. In the light of present day experience and observation, there are no other causes.

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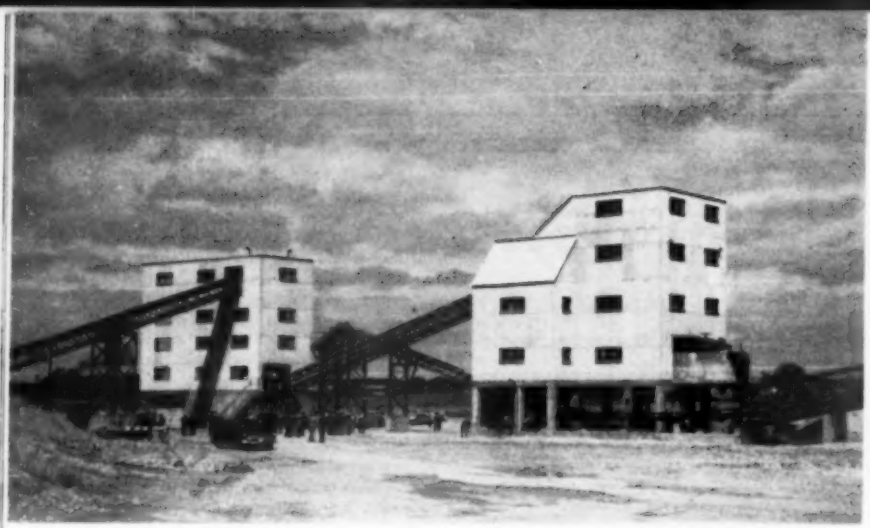
Canadian Lightweight Aggregates

THE DEPARTMENT OF MINES AND TECHNICAL SURVEYS, Mines Branch, Ottawa, Canada, has announced the publication of "Coated Lightweight Concrete Aggregate from Canadian Clays and Shales—Part II," by J. G. Matthews, Industrial Minerals Division. This report contains the results of test work on samples from what are considered the most important known shale and clay deposits within a marketable distance of well populated areas. Most of the samples were collected by the Mines Branch during the summer of 1950 and others were submitted by individuals or companies.

Topics covered in the report include: test methods; relation of chemical properties to the bloating of clays and shales; application of chemical analyses to the problem of producing coated aggregate; location, description and test results of clays and shales in Manitoba; and locations, descriptions and test results of clays and shales in Saskatchewan. A map, illustrations, charts and references are also included.



Design provides large storage over belt conveyor tunnels which permits separation of loading operations from production for flexibility to meet fluctuating demands

Primary crushing building is on left and secondary crushing building on right; conveyor at extreme right is to stacker tower

Canada's Most Modern Gravel Plant

By BROR NORDBERG

ON JULY 9, George Doucette, Minister of Highways for the province of Ontario, Canada, pressed the button to officially start the new sand and gravel plant of Consolidated Sand and Gravel, Ltd., at West Paris, Ont. There were more than 200 invited guests present, including engineers, builders, contractors, railroad officials and representatives of government. We were privileged to be there as a representative of the trade press and as a guest from the United States.

The festivities began with inspection of the plant, which is without question one of the finest in North America. Then followed introduction of the officers and directors of the company by president G. G. Robinson and comments from Mr. Doucette before he threw the switch to start operations. The company later was host to the group at a reception and buffet dinner at the Arlington Hotel in Paris.

Mr. Robinson briefly described the plant and the economic factors considered in its establishment and in its design. The plant is basically a rail-shipping operation, location being on the Canadian National railway for ready access to large markets. The deposit is excellent in its distribution of sizes. It is uniform and provides large reserves. Water supply is from a canal at river level which is fed by the Nith river and by a tributary stream. Tailings from washing are piped to a settling basin in the valley below where there is unlimited space. Electric power is supplied by the Hydro-Electric Power Commission which delivers high voltage 60-cycle current to the company's substation.

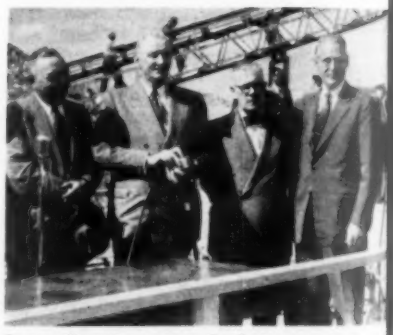
Mr. Robinson commented on the problems being faced by the sand and gravel industry generally, with respect to depletion of deposits from which high quality materials can be produced. A contributing factor to the growing scarcity of deposits, he added, was the fact that specifications for commercial sand and gravel continue to become more rigid with respect to grading and other required properties. He touched upon the fact that sand and gravel are low priced commodities, produced in high volume, that demand low cost production. In his brief comments on the design of the new plant he stressed that emphasis was to cut production costs to the limit, in recognition that a saving of even one cent a ton would amount to a substantial amount in terms of millions of tons of production.

In his brief remarks, Mr. Doucette was highly complimentary of the new plant and was pleased that this new source of material was available for extending Ontario's highways. Apparently, there is heavy demand for sand and gravel for highways, electric power construction and for all other uses throughout Ontario. It was indicated that production from the new plant had a ready market.

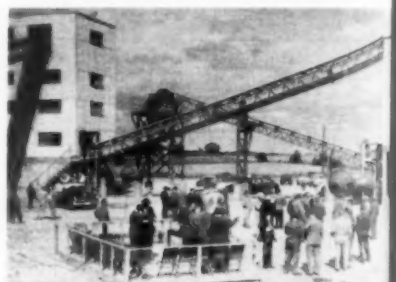
Plant

Consolidated Sand and Gravel operates sand and gravel plants at Waterford, Fuller and Paris, Ontario, in addition to the new one. The older plant at nearby Paris has been in production for 24 years and will continue in operation. The new plant has a rated productive capacity of 350 t.p.h. and can load railroad cars at the rate of 400 t.p.h. It had been in the planning stage for several years and incorporates, in its design, the accumulated ideas of its executives and operating men. R. M. Scrivener was engaged as designing engineer.

The major volume of the business is of minus ¾-in. gravel products and concrete sand, the gravel size separation being made at ¼, ⅜ and ¾ in.



George Doucette presses the button to start the new plant. At right are J. T. Mogan, vice-president, and G. G. Robinson, president



Part of group present for official opening of plant. On left is primary crushing building; secondary crushing building is on right

A fourth gravel product is so-called "paving mix" which is material up to about 1½ in. size. All the sand produced is for use in concrete.

The deposit comprises 250 acres with a 50-ft. face and the size distribution is approximately 50 percent sand and 50 percent gravel. About 30 percent of the gravel must be crushed in order to meet size specifications. Excavation is by a diesel-powered shovel into a skid-mounted hopper with belt feeder, from which flow of material is regulated onto a horizontal

field conveyor. This conveyor transfers to a 36-in. primary belt conveyor delivering out of the pit to the primary crushing building. The field belt conveyor is movable and apparently will be extended as the face develops, to deliver to the primary belt conveyor.

Belt conveyors are used exclusively for intraplant transportation, the total comprising about 3500 ft. of belt conveyor (about 7000 ft. of belting). The plant layout consists of four major units. First, the primary crushing building reduces all material to a top size of 1½ in. for transfer to the secondary crushing building. Equipment consists of a vibrating scalping screen and a Traylor gyratory crusher with 16-in. opening. In the secondary crushing building, the sand is washed from the gravel. It is processed in a Dorr hydroseparator followed by a Dorr rake classifier, the dewatered material being stockpiled by a 24-in. stacker belt conveyor. Recrushing is also done in this building, following screening over two vibrating screens, gravel being delivered by a 24-in. belt conveyor to the stacker tower. Secondary crushing is done by two 36-in. Symons cone crushers and gravel is rewashed over a Symons screen before transfer to the stacker tower.

Two vibrating screens in the stacker house make the gravel separations. The ¼, ⅜, ¾ and 1½ in. sizes are stockpiled by separate stacker belt conveyors. Thus four finished sizes of gravel, and concrete sand, are produced and stockpiled for reclaiming by tunnel belt conveyor in loading railroad cars or trucks. Sand, ¼-in. gravel and 1½-in. gravel are stockpiled over the main belt conveyor tunnel which inclines upward to deliver to the loading station. The belt is 36 in. and the conveyor is on 600 ft. centers. Cross tunnels with 30-in. belt conveyors deliver the ¾- and ⅜-in. gravel on to the main belt. The tunnels are of concrete construction and have a series of loading hoppers with draw-off gates to feed material to the belt conveyors.

The loading station spans two loading tracks. It has four loading hoppers, each holding 1½ carloads of material, with a swivel chute to direct material from the discharge end of the belt conveyor to any one of the hoppers. Loading into cars is directly from or through any one of the four hoppers. Normally, the hoppers are kept empty and are used for storage only in the case of excess tonnage carried by the belt conveyor or if trucks are to be loaded from the hoppers. Control of the loading is from the loading station. A system of light signals has been provided from the loading station to the tunnels to designate the material to be drawn for loading.

About 8500 ft. of trackage was provided, divided into three sidings. Cars are spotted and handled by a 25-ton diesel-electric locomotive.

Above: Sand is separated from the gravel in the secondary crushing building and is processed through this hydroseparator and rake classifier. Right: Pit is a very uniform deposit of about 50 percent sand. Movable pit conveyor feeds to primary belt

Above: Four sizes of gravel are screened in the stacker tower and stockpiled over reclaiming tunnels. Right: This 36-in. primary belt delivers pit-run material to primary crushing building. Belt is fed from the movable belt conveyor in pit

George Doucette, Minister of Highways, Ontario, left, with president G. G. Robinson of Consolidated Sand and Gravel, Ltd.

In this layout of plant, the production of sand and gravel is separated from the shipping operation, which permits independent operation of one from the other. It is possible to build large stockpiles of material without shipping and, conversely, large tonnages may be loaded into cars without operating in the pit. This feature is considered important in view of large fluctuations in demand. Capacity of each stockpile is approximately 6500 tons live storage over the tunnel but, by a single move of a clamshell over a tunnel, the total reclaimable storage is 125,000-150,000 tons of material. Blending can also be done over the primary tunnel conveyor.

The plant is equipped for a thorough job of washing and the volume of water pumped is 1800 g.p.m. Connected electrical load is 900 hp. and the complete electrical system from the stacker tower to the primary pit conveyor is interlocked in sequence. Manual control is also provided. All main electrical circuits are underground.

All the buildings are of structural steel construction and are built to endure. They are roomy to permit easy access to equipment for maintenance. All walkways and stairways are sturdy, with hand rails, and there are guard rails around principal moving equipment, including vibrating screens.

G. G. Robinson is president of Consolidated Sand and Gravel, Ltd., which has its principal office in Toronto. J. T. Mogan, vice-president, has headquarters at Paris and is in active charge of all production.

Loading station has four bins, each of 1½-car capacity

Slag Plant Safety Competition

THE FAIRFIELD PLANT No. 5 of Birmingham Slag Co., Birmingham, Ala., and the East Toledo plant of The France Stone Co., Toledo, Ohio, won highest safety honors, in their respective divisions, in the third annual National Slag Association Safety Competition, conducted by the Bureau of Mines. Bronze plaques, provided by *Pit and Quarry*, were awarded to these winning plants and, in addition, the Bureau of Mines presented each employe and official a Certificate of Accomplishment in Safety.

The Fairfield Plant No. 5 was the trophy winner in the large-size plant group, plants operating 60,000 or more man-hours. This plant operated 180,657 man-hours without a disabling injury during the year April 1, 1951, through March 31, 1952. The trophy award for 1951 was the third successive award to a plant operated by Birmingham Slag Co. Its Wylam open-hearth plant had the best record in the large-size plant group in 1950, and its Thomas plant won the trophy in 1949.

The East Toledo plant won the trophy in the small-size plant group, those operating less than 60,000 man-hours. The plant operated 55,432 man-hours without a lost-time injury. The France Stone Co. is also a third-time trophy winner. In 1950, its Donora, Penn., plant had the best safety record in this group and, in 1949, its Chicago, Ill., plant was the winner.

Of the 45 plants competing in the 1951 competition, 17 had injury-free records. At these 17 plants, including the trophy winners, 907,086 man-hours were worked, or 26 percent of the 3,516,764 man-hours of operation by all the enrolled plants.

The average accident frequency rate for the 45 competing plants was 19.905 injuries per 1,000,000 man-hours, which was slightly higher than in 1950, but approximately 22 percent lower than the rate of 25.393 for 1949. The average severity rate for 1951 was 2.61 days of disability per 1000 man-hours of exposure. This was more than double that of 1950, but 48 percent lower than the rate of 5.035 days for 1949.

The following plants, excluding the trophy winners, received Certificates of Achievement in Safety from the Bureau of Mines for having operated 20,000 or more man-hours in 1951, without a lost-time injury.

Birmingham slag plant, Sloss-Sheffield Steel and Iron Co., Birmingham, Ala.; 119,087 man-hours.

Dock No. 8 plant, The Cleveland Slag Co., Cleveland, Ohio; 82,387 man-hours.

Thomas plant, Birmingham Slag Co., Birmingham, Ala.; 66,185 man-hours.

Midland plant, The Midland Slag Co., Midland, Penn.; 62,403 man-hours.

Donora plant, The France Stone Co., Donora, Penn.; 49,905 man-hours.

Brier Hill plant, The Standard Slag Co., Youngstown, Ohio; 42,690 man-hours.

Monessen plant, Duquesne Slag Products Co., Belle Vernon, Penn.; 39,688 man-hours.

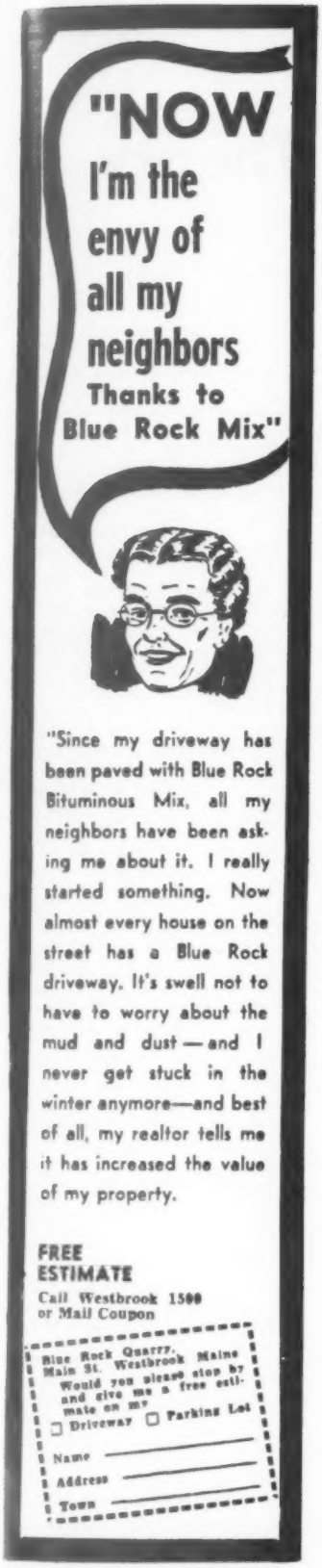
Benwood plant, The Standard Slag Co., Benwood, W. Va.; 39,021 man-hours.

N. D. Connelly slag plant, N. D. Connelly Co., South Chicago, Ill.; 36,482 man-hours.

Portsmouth plant, The Standard Slag Co., Portsmouth, Ohio; 35,887 man-hours.

Jackson plant, The Standard Slag Co., Jackson, Ohio; 32,483 man-hours.

Aliquippa plant, Duquesne Slag Products Co., West Aliquippa, Penn., 20,235 man-hours.



Driveway construction is featured here

One of Blue Rock Quarry's newspaper ads plugging the use of ready-mixed concrete

Newspaper Advertising Pays Off . . .

CONSISTENT NEWSPAPER ADVERTISING is being used effectively by Blue Rock Quarry, Portland, Maine, to promote its crushed stone and related products. The company has built a lucrative driveway construction business that assures a ready market for its various products.

It was about one year ago that the five year old rock products and ready-mixed concrete firm on the outskirts of Portland decided to switch from spasmodic to consistent newspaper advertising. The firm began running ads twice each week in local daily newspapers. The series of ads was assigned one general and one specific objective:

(1) To promote the company's entire range of crushed stone and allied products and maintain its position as one of the leading firms in its field in southern Maine.

(2) To establish the company with homeowners as the top driveway construction concern in the area, at the same time boosting sales of its Blue Rock Mix.

The ads have continued uninterrupted ever since. Copy was prepared by local newspapers and changed but little from insertion to insertion. Art work was obtained from standard newspaper mat services.

"We have been amazed at what consistent newspaper advertising can do," testifies R. W. Shields, general manager. "We now do approximately 75 percent of the total business in this area. We are completely sold on the power of newspaper advertising."

Blue Rock Quarry is now the leading driveway construction company in the city. The company is owned by Joseph Hinman.

Reproduction of advertising on ready-mixed concrete. Note the eye-catching signature line at the bottom of the ad

Crushing Practice and Theory

Part IX. Special types of roll crushers

By BROWNELL McGREW*

ROLL CRUSHERS of the sledging type have a crushing action unlike that of any of the machines thus far described. Moreover, the actions of the single- and double-roll forms of this type are dissimilar, at least in the relative importance of impact and sledging action. Both types employ a combination of these two actions but in a reversed order of efficacy.

Inasmuch as a sledging blow transfers a large part of its force by impact, it may seem anomalous to attempt to differentiate these two terms; nevertheless there is a convenient distinction between them as they apply to the action of crushing machines. Impact crushing is customarily taken to mean the breaking of a piece of material by a sharp blow, delivered with sufficient force to shatter the piece while it is in a free position, i.e., not restricted from moving away from the blow other than by its own inertia. Sledging, while the blow may be just as violent as the impact blow, is a stroke delivered against the material while it is prevented from moving away from the applied force by reason of being in contact with an opposing crushing surface, either fixed or moving.

Single-Roll Crushers

Fig. 1 shows a sectional elevation of the A-C single-roll crusher, known as the Fairmount crusher. Fig. 2 shows a cutaway view of the machine, with hopper and part of the near side frame removed to show the crushing chamber.

The moving elements of the machine consist of the roll, with its supporting shaft and driving gear, and the pinion-shaft on which are mounted the pinion and driving pulley. The fixed member of the crushing chamber, known as the anvil, is supported near its upper end by a heavy cross-shaft; the lower end is held in position by a transverse equalizer beam (anvil beam), to each end of which is attached a pair of heavy tie-rods. These rods, at their upper ends, pass through two nests of strong springs, which serve the double purpose of shock absorption, and equalization of tension on the rods. The anvil is positioned at its lower end by shims, placed between the ends of the anvil beam and the side frames. The entire mechanism is supported by the pair of heavy and rigid side frames, which are tied together by stiff cross-members at each end.

The curved crushing surface of the anvil is lined with chilled-iron or manganese-steel concaves, which are cast with corrugated faces. These corrugations sometimes extend the full length of the surface, but when a fine product is desired the lower concave segments are made with a flat surface at the discharge point. The roll-center is made of cast steel, and the teeth are of manganese steel inserted in cored pockets in the surface of the roll-center. These teeth, it will be noted, are of different heights, the higher teeth being known as "slugger teeth," and the lower ones as "regular teeth."

Crushing Action

The tip-velocity of the slugger teeth in the Fairmount crusher is from 400 to 450 ft. per min., or in the neighborhood of 7 ft. per sec. The working faces of the teeth are radial in profile, which means that the faces are normal to the line of action when a rock is contacted in any part of the crushing chamber.

When a mixed load of quarry-run stone is dumped into the hopper of the single-roll crusher the following stages may be observed: first, there is a pronounced selective segregation; the entire load is subjected to vigorous agitation, causing the smaller pieces of stone to sift down through the mass of material into the crushing chamber, where they are reduced by a succession of sledging impulses from both regular and slugger teeth as the broken and re-broken pieces are worked down the curved face of the anvil to the discharge point. During this stage, if there is any considerable amount of fine material in the load, the large pieces of rock are shoved up and held away from the roll by the mass of smaller pieces. As the crusher clears itself of the small stone the larger blocks come down into the zone of action. Here, too, there is a certain degree of segregation; the crusher seems to have an uncanny faculty of weeding out the small fry, then the middleweights, and finally taking on the heavyweights.

Unless the stone is of a friable nature very little breaking is done on top of the roll, i.e., by pure impact action; therefore these machines are not suited for crushing stone of massive or blocky structure. They are highly effective on stratified rock, where the maximum thickness of ledge is within the dimension which can be nipped between the advancing slugger teeth and the anvil. Working on such stone, the crusher will handle any size piece that will enter the upper part of the crushing chamber. Large slabs which lodge against the anvil at their lower end are fractured by the action of the slugger teeth beneath them, or are up-ended and thrown against the anvil and the back of the hopper, where they are held while the slugger teeth work on them from the bottom.

Naturally, during the action we have described, the agitation in and above the crushing zone is quite

Fig. 1: Sectional elevation of 36- x 60-in. single-roll crusher, Fairmount type

*Allis-Chalmers Manufacturing Co., Los Angeles, Calif., district office.

violent, and therein lies an outstanding feature of this crusher. The continuous heaving of the material minimizes bridging, making the crusher to a large extent self-feeding. Such bridges as do occur can frequently be broken by the simple expedient of throwing in a single piece of stone of sufficient size to raise the bridged material as the stone passes underneath it. Bridges may also be broken by dumping a load of small rock into the crusher; the selective action we have described will generally break the bridge unless the bridged pieces are very firmly wedged.

Blockades caused by single pieces of stone too large to enter the crusher are a more serious matter, and are usually more difficult to break than in the gyratory or jaw crusher, due to the fact that the process requires some care to minimize the element of personal danger.

Product

On the soft and medium grades of stone, to which the single-roll crusher is particularly well adapted, the machine will turn out a product carrying less fines than will either the jaw or gyratory types; in fact, the product of the single-roll machine on soft rock will generally compare favorably, on this score, with that of the other two types on hard rock. There is no tendency to build up a packed condition in the lower part of the crushing chamber; rock reaching this lower zone is quickly and forcibly discharged. Moreover, the selective characteristic of the crusher minimizes attritional action by getting the fine material out of the way quickly, and most of the crushing is done by clean, sharp sledging blows against the individual pieces.

The size of product is governed by the distance between the roll and the tip of the concaves at the lower end of the anvil, which corresponds to the open-side discharge setting of the jaw and gyratory types. There will of course be some difference in the size of product, depending upon whether the concaves are smooth or corrugated at the discharge point. With smooth concaves, and operating on soft or medium stone, the product will average from 80 to 85 percent passing a square opening equivalent to the discharge setting. With corrugated concaves the product will be somewhat coarser. If the rock is hard the lower end of the anvil will be forced away from the roll a little when the crusher is fully loaded, due to compression of the springs, and this may increase the square-opening size of product by as much as 1 in.

The single-roll crusher is essentially a primary crusher, and general results will be better if the installation is engineered with that thought in mind. The machine will function more satisfactorily and economically when fitted with corrugated concaves, and set for a medium or coarse product, than when fitted with concaves which are smooth at the discharge point, and set "tip-to-tip."

Feed Size

Unless the rock is exceptionally friable the maximum thickness of the feed should not exceed that thickness which the crusher can effectively nip between the advancing slugger teeth and upper part of the anvil; the only breaking done on top of the roll should be the beam-action breaking of long slabs. For that reason the maximum advisable thickness of ledge is established by the distance between the face of the anvil, and the point of contact on the face of the roll where the teeth can get a full "bite" on the rock. This of course is a function of the roll diameter, which governs the general proportions of the crushing chamber.

The 24-in. diameter Fairmount crusher has an effective nip of about 14 in. maximum; the 36-in. machine will grip stone up to about 24 in. maximum; and the 60-in. crusher will handle ledges up to about 36 in. thickness. These thicknesses are based on limestone of medium hardness; for harder materials the advisable thickness is somewhat less.

So far as width is concerned, the crusher will handle any piece that will enter into the crushing chamber between the side liners. There is no practical limitation to the length of the feed, so far as the crusher itself is concerned. If the piece is not too thick the machine will break any rock that can be maneuvered end-on into the crushing chamber.

Capacity

The capacity of the single-roll crusher is influenced by the nature of the feed to a much greater extent than is the case with any of the types discussed heretofore. The two factors which have a very important bearing on capacity are thickness and hardness, or toughness. Blocky material which must be broken on top of the roll will, unless the stone is very friable, require a considerable amount of hammering by the slugger teeth to reduce the blocks to sizes that can be gripped between the teeth and the anvil—all of which is a time consuming process. The harder the material is, the more time will be consumed in such impact breaking. Hardness or toughness also has a retarding effect upon the sledging action on the smaller pieces of material; instead of shattering, as soft rock will under these sledging blows, the harder material snaps off in small pieces at the point of impact, which means that more blows are required to reduce each individual block—again a time consuming operation.

Because the action of the crusher is of this nature, it is not practicable to give the various crusher sizes a unit capacity rating to correspond to each discharge setting, or product size, as can be done with reasonable accuracy for the gyratory and jaw types. It is necessary to predicate the ratings upon selected values of hardness and maximum thickness of the feed, as well as the discharge setting. In Table I this has been done for four sizes of the Fairmount crusher. The material upon which this table is based is a medium limestone, of 8000 to 10,000 p.s.i. crushing strength. On this basis ratings are given for different thicknesses of feed, and for different product sizes.

(Continued on page 168)

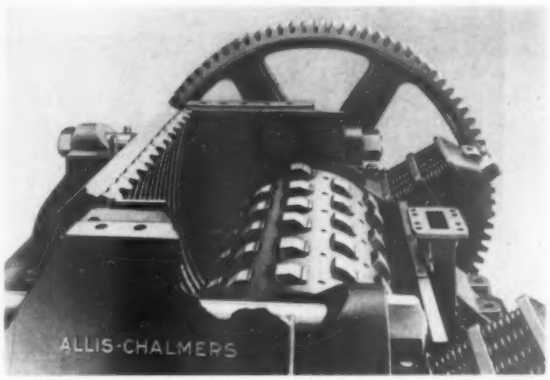


Fig. 2: Cutaway view of a 60- x 84-in. Fairmount-type crusher

Table I. Fairmount crushers—approximate capacities

Size of Crusher	24 x 48 in.				24 x 60 in.				36 x 60 in.						60 x 84 in.
Maximum thickness of feed (inches)	14	14	12	12	14	14	12	12	24	24	20	20	16	16	Stone too large for smaller crushers
Ring size of product (inches)	4	6	4	6	4	6	4	6	6	8	6	8	6	8	10 to 14
Capacity tons per hour of medium limestone	115	175	130	200	145	215	165	250	250	325	300	400	375	500	500 to 1500
Motor horsepower	100	75	75	75	125	100	100	100	200	200	200	200	200	200	300 to 400
R.p.m. of roll	58				58				39						23
R.p.m. of pulley	282				282				210						129

Note: Capacities are based on material weighing 100 lb. per cu. ft. and are given in net (2000 lb.) tons.

AGGREGATE IS WHERE YOU FIND IT!

TODAY a cotton or cornfield, or pasture—tomorrow a thriving sand and gravel business. That's the history of many producers — the ones that produce material to meet exacting specifications.

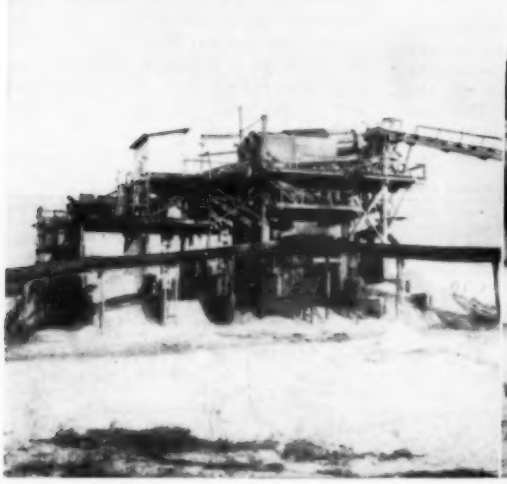
Such a producer is Becker County Sand & Gravel Co. — one of America's largest. With its headquarters in Minnesota and various plants in Minnesota and Iowa, Becker County is operating a number of highly successful plants in the South.

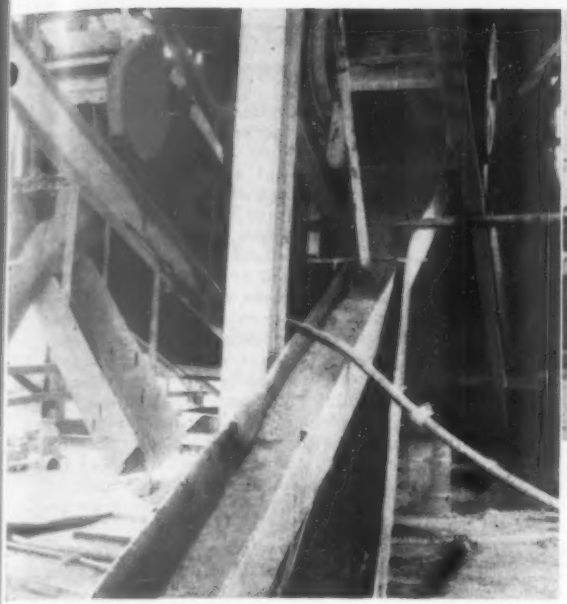
The aggregate was there—they found it—they process it to meet exacting specifications. Deposits are very difficult in some cases. Typical "Dixie" plants of Becker County Sand & Gravel are shown.

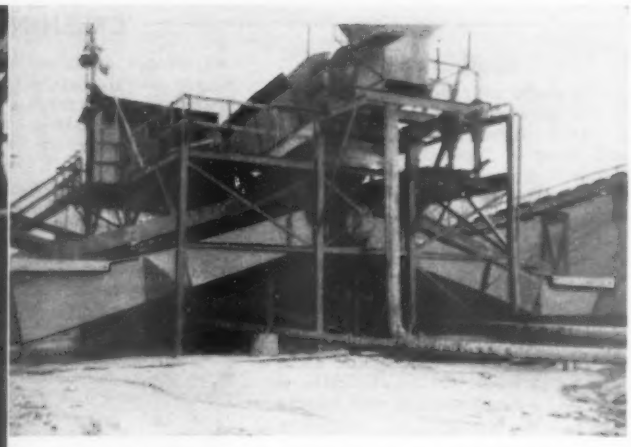
Below: Material is conveyed from pit across Cape Fear River to plant on opposite shore, at Becker County's Fayetteville, North Carolina plant — shown at bottom.

Bottom left. Two Eagle Fine Material Washer-Classifier-Dehydrators provide two gradations of sand at this plant.

Bottom right: Camden, South Carolina plant of Becker County Sand & Gravel Co. — three Eagle Screw units assure premium materials.







Above: Kathwood, South Carolina plant — four Eagle Double Screw units provide an abundance of clean, classified material.

At left: Cheraw, South Carolina, plant uses two Eagle Screw units to assure specification materials.

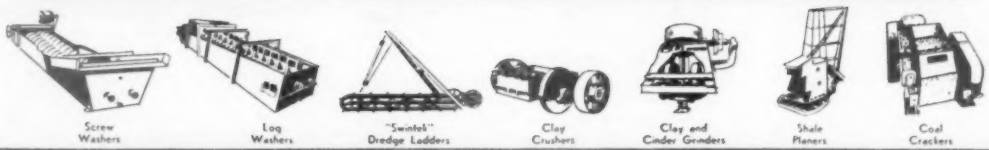
Eagle WASHING AND CLASSIFYING EQUIPMENT MAKES IT USABLE

Successful producers everywhere turn to Eagle for dependable recommendations based upon over 35 years of experience. The design and construction of Eagle Washing & Classifying Equipment is the result of literally thousands of installations. We learned "the hard way" and today users of Eagle equipment reap the benefit.

Correct tub design, proper screw pitch and r.p.m., proved positioning of wash water inlets and volume of water to the rising column of wash water, tested weir design —all are important factors. They are combined in Eagle Screw units to assure maximum performance and long service life for any aggregate producer. Today's rigid specifications **plus** competition dictate your consideration of Eagle equipment. Send for the facts!

EAGLE IRON WORKS

137 Holcomb Ave.
Des Moines, Iowa



Applications

The single-roll crusher, as compared to the gyratory and jaw types, has a rather limited field of application, and being a "specialist" it is only fitting that it should be exceptionally proficient in the field for which it is adapted. It is a highly effective primary breaker for such materials as the soft-to-medium limestones, dolomite, magnesite, phosphate rock, cement rock and shales. It is decidedly not a hard-rock crusher, nor is it suited for rock of massive or blocky structure unless it is, at the same time, of friable texture. Practice is to limit its application to rock having a crushing strength not exceeding 15,000 p.s.i.

During the crushing process, particularly when material is riding on the roll, there is considerable slip or rubbing action between the material and the tops of the teeth, and this will obviously result in rapid wear if the rock is at all abrasive. For that reason this crusher is not economically suited to the handling of rock containing more than a few percent of free silica—unless, again, it is very soft and friable.

By virtue of its positive discharge characteristic the single-roll crusher ranks as a top performer in the handling of wet and sticky material, and it will take care of stone containing a substantial admixture of loam or clay. In this respect we would rate the currently leading types of primary breakers in the following order:

1. Single-roll crusher
2. Jaw crusher
3. Gyratory crusher

Some very soft materials—fuller's earth, for example—do not handle well in the single-roll crusher, clinging to the anvil and refusing to work down into contact with the teeth. Clay and similar sticky material will of course behave in the same manner, but if there are enough pieces of solid rock in the load, the machine will keep itself clean by using the rock as a scouring agent.

Because it is a proficient self-feeder the Fairmount crusher may be fed directly from cars or trucks, discharging into a plate steel superhopper of suitable proportions, this hopper being superimposed on the heavy cast hopper which is a part of the machine. If the loads are not too large with respect to the size of the crusher, the entire load may be dumped at once, without much risk of bridging. For very large cars or trucks controlled dumping is preferable.

Double-Roll Crushers

Although its brief period of popularity passed some thirty-odd years since, and only a few sets were installed before interest reverted to other types, the high-speed double-roll crusher developed by Thomas A. Edison shortly before the end of the last century warrants a place in any discussion of crushing equipment. The largest machine of this type—the 6- x 7-ft. "giant" rolls—are huge crushers, judged even by present-day standards; they have an unobstructed receiving opening 7 x 7 ft. and their capacity on individual skip-loads of stone is enormous, although, as will be explained, they cannot maintain this peak capacity over a period of time.

Mechanically, the Edison roll crusher is a very simple machine. The two rolls are carried in bearings, supported on two very heavy and rigid bed castings which are secured on the concrete foundation by a number of large anchor bolts. The bearings, in addition to being bolted to these bed castings, are prevented from spreading by pairs of large tie-rods which pass through them above and below the roll shafts. Unlike the smooth-face crushing rolls we have described, these tension rods are not cushioned by springs. The machine is surmounted by a heavy cast rectangular hopper, all sides of which are vertical. Each roll is independently driven by a flat-belt pulley.

The roll-centers are octagonal in cross section, each face being provided with a spline groove and a series of tapped holes for securing the chilled-iron wearing plates. These wearing plates have the sledging knobs, or teeth, cast on their outer surfaces. Thus we have a roll surface that resembles that of the Fairmount crusher, except that the faces of all teeth are sloped instead of radial on the advance side. The usual practice is to fit one roll entirely with so-called regular teeth, and the other roll with six rows of regulars and two rows of higher (slugger) teeth.

The peripheral speed, or tip-velocity, of these rolls is much higher than that of any of the machines we have previously described. The range of the smooth-face rolls, for example, is from about 400 ft. per min. for the small 12-in. rolls, to 2000-2200 ft. per min. for the heavy-duty 72-in. machine. (The single-roll crusher has a tip speed of 400-450 ft. per min.) The 6- x 7-ft. Edison crusher has a normal (no-load) surface speed of just under 3500 ft. per min.

It can be readily appreciated that this high velocity induces an extremely violent crushing action, in conjunction with the 3- to 4-in. knobs which protrude from the roll surfaces. Impact, sledging, and pressure crushing enter into the over-all performance; but impact, in this crusher, plays a far more important role than it does in the slower speed single-roll machine; and crushing, even well down along the roll faces, is more in the nature of a sledging action than it is of pressure crushing, for this action occurs in the lower-velocity crushers.

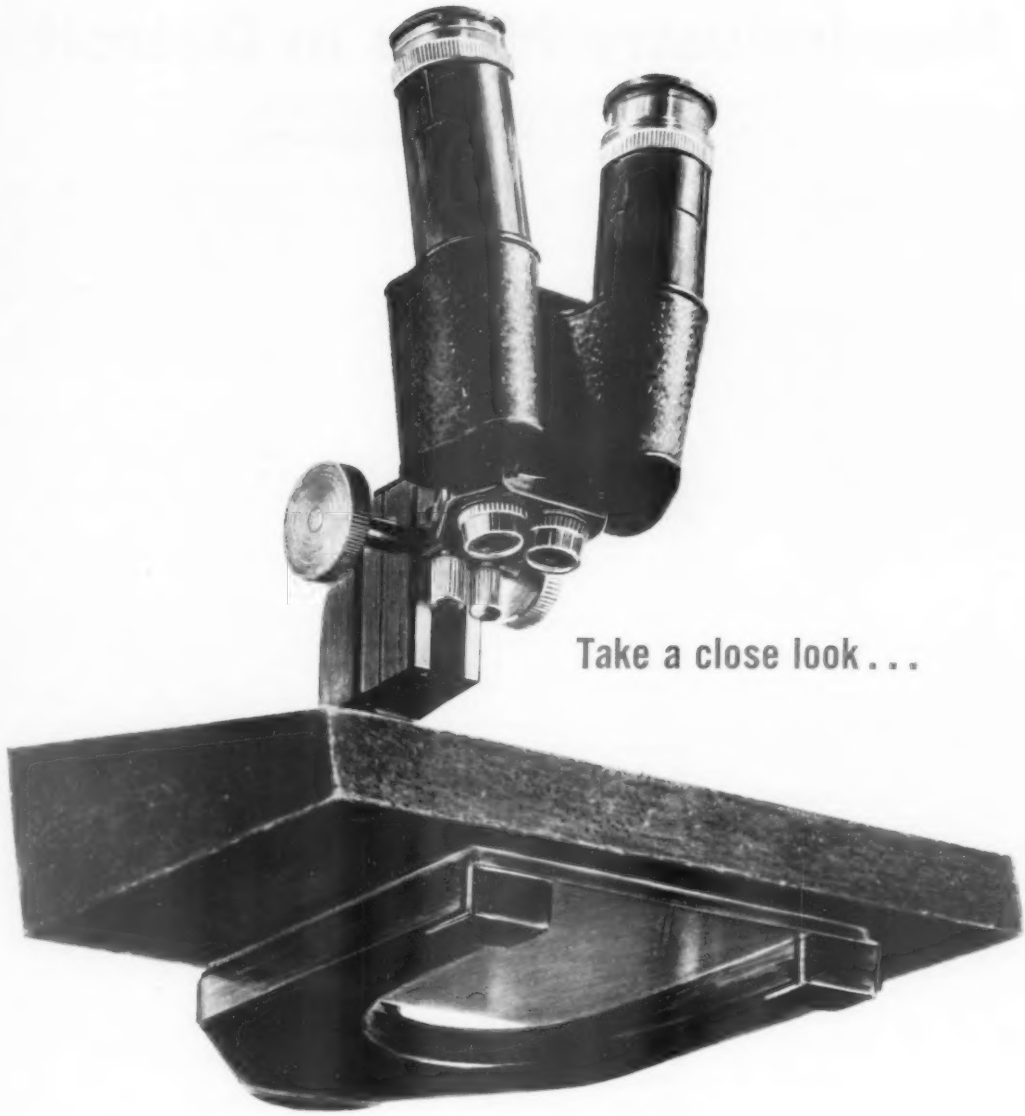
The theoretical maximum size of cube that the knobs will grip, when the rolls are set at minimum spacing, is 24 in.; but the rolls will reduce any stone that can be introduced into the 7-ft. square hopper. Large blocks will span across the tops of the two rolls; immediately the slugger teeth on the one roll so equipped go to work on these blocks and quickly shatter them into pieces that can be gripped between the sets of regular teeth; from this point on, the action is a mixture of sledging and pressure crushing. The same selective segregations which we described in connection with the single-roll machine occur in the double-roll crusher; the smaller pieces are cleared quickly, leaving the rolls free to work on the larger blocks.

The entire performance on individual skip-loads of stone takes place in a very short period of time. Ten-ton loads of mixed-size medium limestone will clear the crusher in from 10 to 15 sec.; large single blocks, weighing from 6 to 8 tons, are crushed in from 5 to 20 seconds, depending upon the toughness of the individual piece, and upon the way it happens to land in the crushing chamber. These performances were clocked on machines turning out a 6-in. product.

The short-time transfer of energy, especially when crushing large blocks, is very high; so high in fact that it would not be economically feasible to provide sufficient motive power to deliver it. The usual practice, when these rolls are driven electrically, is to drive the slugger roll with a 250-hp. motor, and the regular roll with 200 hp.—a total of 450 hp. As compared to this motive power, instantaneous energy delivery may run as high as 4000 hp.—obviously far beyond the capacity of the motive equipment. But the rolls themselves, when running at normal no-load speed, have a stored kinetic energy of upwards of 4,000,000 ft.-lb., and it is this stored energy that does much of the actual crushing, the motors serving to bring the rolls back to normal speed between crushing periods. In crushing a skip-load of stone the rolls may lose anywhere from 30 to 60 r.p.m. in speed; this loss occurs partly through slowing down of the motive equipment, and partly through belt slippage. It requires from 5 to 10 sec. to bring the machine back to speed, during which time the power input will vary from 400 to 600 hp. The power required to run the rolls empty is something less than 100 hp. The average power consumption, when crushing from 3000 to 4000 tons per 10 hr. day will run in the neighborhood of 150 hp. on medium limestone.

While the average power consump-

(Continued on page 188)



It's designed especially for top kiln performance!

TAKE a close look at Permanente Periclase-Chrome bricks for rotary cement kilns and you'll find they cut down-time for replacements to a minimum—give you higher production. That's because they are *developed especially* for hot zone linings.

Their special design combines high purity, pre-shrunk periclase grains with an *exclusive* patented bonding medium. Result: a kiln lining of maximum refractoriness with high resistance to chemical attack by cement clinker.

Verified performance records show that Permanente Periclase-Chrome brick have withstood as many as *17 shutdowns for various causes without any loss of brick due to spalling.* They take a good coating, hold it well, and have great resistance to thermal shock.

If you feel that an appraisal of your rotary kiln performance would be helpful, Kaiser Chemicals will be glad to work with you. Installation assistance also is available at no extra cost.

Standard brick sizes supplied in both burned and chemically bonded forms. Recently expanded facilities insure superior service. Call or write principal sales offices: *Chemical Division,* Kaiser Aluminum & Chemical Sales, Inc., 1924 Broadway, Oakland 12, California. First National Tower, Akron 8, Ohio.

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Pioneers in Modern Basic Refractories

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Slag Industry Meets in Detroit

Progress in research and specifications reported; industry exempt from renegotiation

THE MID-YEAR MEETING of the National Slag Association, held July 9 and 10 at the Sheraton-Cadillac hotel, Detroit, Mich., heard reports on all principal activities since the last annual meeting and featured an entire day of plant visits and entertainment which added up to one of the best mid-summer meetings of the group.

Ed Levy, Edward C. Levy Co. of Detroit, was host to the group for the entire first day. It started with a trip through his company's modern slag plant. After luncheon at the Dearborn Inn, the group had an escorted tour through the Ford plant. Members and their wives and guests were guests at dinner held at Devon Gables and the day ended with a theater party.

President C. A. Barinowski presided for the business session held on July 10. The first order of business was a unanimous vote to make Harry J. Love an honorary member of the board of directors. R. C. Jackson of Rockwood Slag Products Co., Rockwood, Tenn., a new member company, was elected a member of the board of directors.

Managing Director's Report

Managing director E. W. Bauman then reported on the status of the various current activities of the association. He had several favorable reports to make. For one, the industry, after considerable effort, has been explicitly exempted from the Renegotiation Act of 1951. Whereas exemption had been granted other natural materials, there had only been an implication that slag was exempt and the association had been seeking definite clarification. As it turned out, the ruling was that slag was exempt, as a by-product to a raw material (pig iron) which had been declared exempt.

The association, through its technical problems committee, has held a number of meetings with the Portland Cement Association in an effort to have a revision made in P.C.A.'s bulletin "Design and Control of Concrete Mixtures" which would be more favorable to slag in the tables for cement factors with various aggregates. The table for cement factors for specific water-cement ratios which had required more cement for use with angular aggregates than with rounded aggregates is now revised to remove that differential. The N.S.A.'s contention has been that more cement is not required for angular aggregates in the attainment of strength and durability of concrete.

In his comments on advertising and promotion, Mr. Bauman said that there is a wealth of material on the uses of slag which should be exploited in the form of literature. The association is to have a section in Sweet's Catalog this year, which is in process of preparation. It will feature uses of slag and recommended specifications for slag.

Price control came in for brief comment. Users of slag for bituminous and portland cement concrete, by a recent supplemental ruling, are permitted to increase their prices to compensate for freight rate increases since 1951. There is no provision granting price relief to producers of slag. The industry is planning to push its case for de-control and, if unsuccessful, will request price adjustment based on increased wage rates. Further wage increases are anticipated after the steel strike is settled. A compensating price increase will be sought nationally for the industry.

It is expected that a severe steel shortage will adversely affect the industry's ability to secure its equipment needs under N.P.A.

Research sponsored by the association on agricultural slag has made progress. A report on the Ohio research project will soon be made and it is expected that it will disclose favorable findings. A report on the association's agslag research at the University of Maryland has already been presented but this report gave emphasis to soil neutralization rather than to crop-increasing effects.

The Federal Aid Highway bill recently passed is expected to guarantee a high level of construction for the next two years, with some $130,000,000 of federal aid to be made available in the nine states of greatest interest to the slag industry.

The report on the association's program at the Underwriters' Laboratory to establish fire resistance ratings for expanded slag concrete masonry units is soon to be made available. In these tests, 2-, 3- and 4-hr. ratings will be issued based on the thickness of units rather than on the basis of weight.

According to Mr. Bauman, reports indicate that the industry had an excellent year in 1951.

The industry believes that it is entitled to percentage depletion but has been denied such benefits because slag is not from a natural deposit. The industry is at a competitive disadvantage as a result and will continue its efforts to develop a case for percentage depletion.

Engineering Director's Report

Engineering director Fred Hubbard commented in greater detail on some of the projects discussed by Mr. Bauman. In his discussion of the work with the Portland Cement Association on design tables, he said that there was a half sack of extra cement required per cubic yard of concrete before the tables were changed, where angular aggregates were used instead of rounded aggregates. In his opinion, too much emphasis had been given in these published pamphlets on the value of the water-cement ratio in the design of concrete without proper consideration of other contributing factors.

Mr. Hubbard has been summarizing information on the physical and chemical characteristics of the various expanded slags from all sources. He has developed very complete information on the subject, of value in tests and research. This study was originally undertaken preliminary to the fire tests.

Because there have been claims made of corrosion of metals when embedded in blast furnace slag, Mr. Hubbard is conducting tests which he believes will disprove the complaints. He believes there has been confusion as to the identity of other materials which have been assumed to be slag, when complaints have arisen. In his tests, lead, galvanized steel, copper and other piping have been laid in trenches and covered with granulated slag, regular slag and screenings—also gravel, mill ashes and other materials. After two years, the pipe will be examined for corrosion.

English Slag Industry

W. E. Bliss reported his observations of slag gained on a recent trip to England. About 5,500,000 tons of air-cooled slag are sold annually by an industry comprising 28 companies. Production of expanded slag is about 150,000 tons annually. About 60 percent of the air-cooled slag is sold in the coated form and much of the balance is coated by customers. No water is applied and the slag can be coated with tar without a preliminary drying step.

Mr. Bliss described a typical operation where two pits, each 3000 ft. in length, are used in the production of 1500 tons of slag per day. The slag is cooled in the ladles for a period of 18 hr. before dumping, and large balls of slag, ladle-size, are dumped into the pits. The conventional contract with steel manufacturers is for a 21-year period.

Mr. Bliss described the manufacture of expanded slag by the Gallia-bed method which, he said, yields a very uniform product of high quality. The slag is processed on porous concrete beds with water pyres below. The thickness of the layer on the bed controls the density of the product. It requires 15 minutes to process slag from a ladle of 8-15 tons, after which a

dragline removes the clinker to a blending pile. The product weighs as little as 32 lb. per cu. ft. The industry is now developing a method to produce a slag of 15 lb. per cu. ft. that would be competitive with perlite and vermiculite in their special applications.

Mr. Bliss recommended that the National Slag Association make a study of the Gallia-bed process in England, and also in Germany and France where the process is also in use. Discussion developed that this process might not be adaptable to the much greater tonnages required in the United States but the association will make an investigation.

A number of prominent building officials were invited guests at lunch, following the business meeting, and the wives of the members were also invited. George Thompson, chief engineer of the city of Detroit, was the featured speaker. Mr. Thompson told of wide use being made of slag aggregate throughout the city and gave the product his strong endorsement.

Following Mr. Thompson's speech, the bronze safety trophies awarded by *Pit and Quarry* were presented to the winners of the N.S.A. safety competition for 1951. Winner in the large plant classification, for plants operating in excess of 60,000 man-hours, was the Fairfield, Ala., plant (No. 5) of Birmingham Slag Co. The company is now a three-time winner. The plant operated 180,657 man-hours without injuries and time lost. Charles Ireland accepted the trophy. In the small plant classification, the winning plant was the East Toledo, Ohio, operation of France Stone Co., which had a perfect safety record for 55,432 man-hours worked. The company is also a three-time winner. Dr. H. F. Kruge accepted the trophy. Certificates were awarded to other winning plants in the competition, for which the Bureau of Mines compiles the records. All the winning plants are listed in a separate article in this issue (page 162).

Seth Reece, Bureau of Mines, concluded the subject of safety with a plea for greater efforts to reduce injuries. He expressed great pleasure in the slag industry's progress. In 1949, the first year of the competition, the frequency rate was 24.3, the figure was reduced to 19.7 in 1950 and the 1951 figure was 19.2, for the 35 plants competing in these competitions.

By comparison, he said the anthracite mining industry of northeast Pennsylvania had a frequency rate of 82.3 in 1951, the bituminous coal industry record was 23.5, metal mines 29.5, nonmetallic mining operations 26.1, nonmetallic open pits 32.9, and quarries 14.4. Average for this group of industries was 28.1. The slag industry's severity rate in 1951 suffered by reason of one fatal accident.

The next annual meeting of the N.S.A. will be November 12 and 13 in Washington, D.C. Selection of the hotel will be announced when arrangements are completed.

PROSPECTING FOR SAND AND GRAVEL

Texas Construction Material Co. uses a geophysical rotary drill to prospect for sand and gravel reserves

By WALTER B. LENHART

SAND AND GRAVEL deposits along the Colorado river near Columbus, Texas, extend for several miles on the east bank and include the Alleyton and Eagle Lake sections. Because of the shallow nature of the deposits, the plants located there are either portable or semi-portable. Many deposits have practically been depleted, forcing producers to move to the west bank where rail facilities are not yet available. Thus, material has to be transported across the river to reach the railhead, a costly operation.

One of the major producers in this area faced with depletion of resources in the foreseeable future is Texas Construction Material Co., main offices of which are in Houston. The company operates 12 plants in five locations, two of the plants located along the Colorado near Columbus (approximately 75 miles due west of Houston). Because of the shallowness of the deposits and their exhaustion, the company carries on prospecting well ahead of exploitation. A separate department has been set up, called the Land-Lease Department, under the direction of E. H. Lawrence.

Emptying bailer into sample collecting box

The prospecting crews use a rotary drill adapted from a geophysical drill made by Frank Machine Co., Enid, Okla. The unit is mounted on a tandem axle truck. It uses an 8-in. steel casing and can drill to a 1500 ft. depth if necessary. However, drilling in the Columbus area is confined to 60 to 100 ft. depths. Holes are drilled on 210 ft. corners, or a drill hole at the corner of each acre is prospected. From the data secured from each hole an area map is drawn up, showing the number of feet of top soil, footage of bottom soil, feet of good gravel, fair gravel, sand, low grade gravel and very low grade gravel.

The 8-in. casing used is divided into 5 ft. sections, with heavy thread connections joining each length. The lower end section is provided with a cutter edge that is replaceable and resembles saw teeth around the end of the casing. When drilling through top soil no bailer is needed or required and the mud is removed by recirculation of the liquid pulp. On reaching a sand and gravel deposit a bailer is used. The cutter edge is kept 2 to 5 ft. ahead of the bailer.

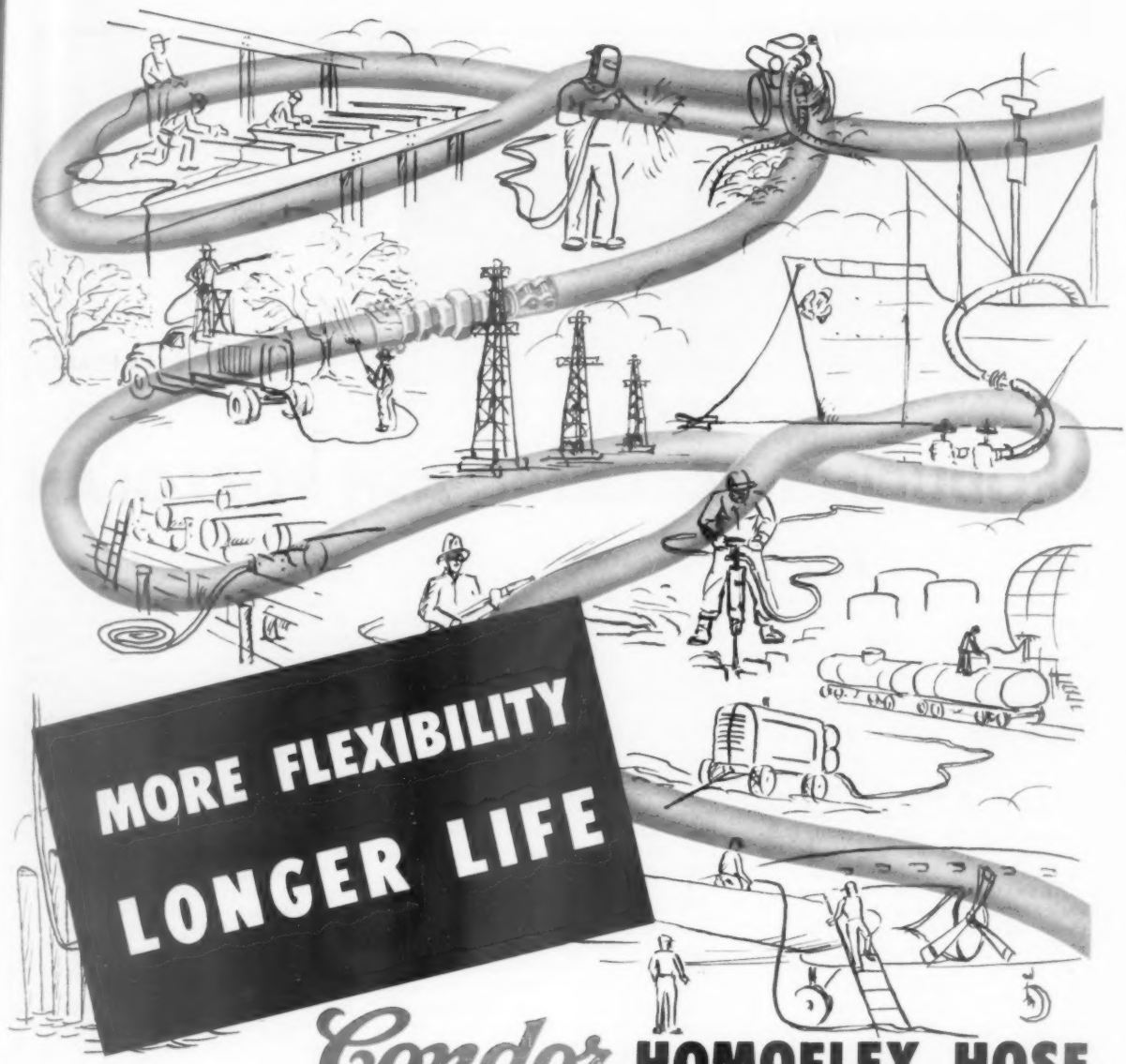
The bailer is an 8 ft. length of 6-in. dia. pipe having a flap valve at the lower end. It operates inside the casing. The steel cable on the bailer is fastened to an eccentric arm that is a duplicate in miniature of the method of operating the drill on a churn drill. This frequent raising and dropping of the bailer tends to create a suction that draws pieces of gravel almost as large as the pipe itself into the bailer and holds them there by the flap valve. The rate when drilling surface soils is 75 ft. per hr. With the bailer a 70-ft. hole can be put down in 3½ to 4 hr. The unit is powered by a Ford V-8 engine mounted on the flat deck of the truck.

Gravel in the area is mostly minus 3 to 4 in. and is an extremely hard and durable material. However, an occasional piece larger than indicated is uncovered but such pieces are so few they aren't a factor in the final appraisal of the deposit. The gravel and sand are totally free of anything that reacts under ultra-violet light, so reactivity presumably is not a problem here.

Personnel

Headquarters of Texas Construction Material Co. are at 1919 Travis St., Houston, where the company has its own modern office building. E. Phil Gemmer is president and general manager; D. W. Baker is vice-president and production manager and Bob Klossner is production engineer.

Length of casing is added as the hole deepens



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General view of Valley Brick & Tile Co.'s pozzolan plant. At left is the loading bin (horizontal cylinder) and separator

Valley Brick & Tile Co.'s Rio Grande City plant supplies pozzolanic material for Falcon dam

By WALTER B. LENHART

PRODUCING VOLCANIC ASH POZZOLAN

USE OF POZZOLANS in the replacement of part of the portland cement in concrete has come into prominence in recent years and continues to evoke interest. Evidence of the growing use of pozzolans can be seen in several of the projects of the U.S. Bureau of Reclamation. Four dams, to name a few examples, that were built or are being built using pozzolans are Friant dam in California where pumicite was used, Davis dam in Arizona with calcined shale, Hungry Horse dam in Montana with fly ash, and Falcon dam, a joint U.S.-Mexican project on the lower Rio Grande.

At Davis dam a pozzolan (calcined shale) made by California Portland Cement Co., Colton, Calif., was used as an additive and as such acted also as a replacement for portland cement. It was also used as a corrective for the so-called reactive aggregates. At Hungry Horse dam, fly ash shipped from the Chicago area is being used. Considerable financial savings were said to have been effected at Hungry Horse where roughly one sack of fly ash replaced a sack of cement in a cubic yard of concrete; this saving was in spite of the fact that the freight from Chicago to Hungry Horse was said to be about $10 per ton.

At Falcon dam now under construction, and which was described in the July, 1952, issue of ROCK PRODUCTS, page 69, a pozzolan made locally by Valley Brick & Tile Co., with headquarters at Mission, Texas, is being used. The manufacturing plant is at Rio Grande City, about 40 miles up the river from Mission and nearer the dam construction site.

Why Pozzolans?

Essentially, the advantages of using pozzolans are said to be improvement of the properties of the concrete, as well as a saving in the cost of concrete. Use of suitable pozzolans results in concrete having better workability, less heat generation, maximum rate of heat development at an earlier age, less water gain and segregation of solid ingredients, lower permeability, greater resistance to aggressive soils and waters, and, with some pozzolans, reduced expansion from alkali-aggregate reaction. The properties of pozzolans vary widely and some introduce adverse qualities into the concrete, such as excessive shrinkage and reduced strength and durability.

Pozzolans can be classified on the basis of their mineralogic and petrographic composition as follows:

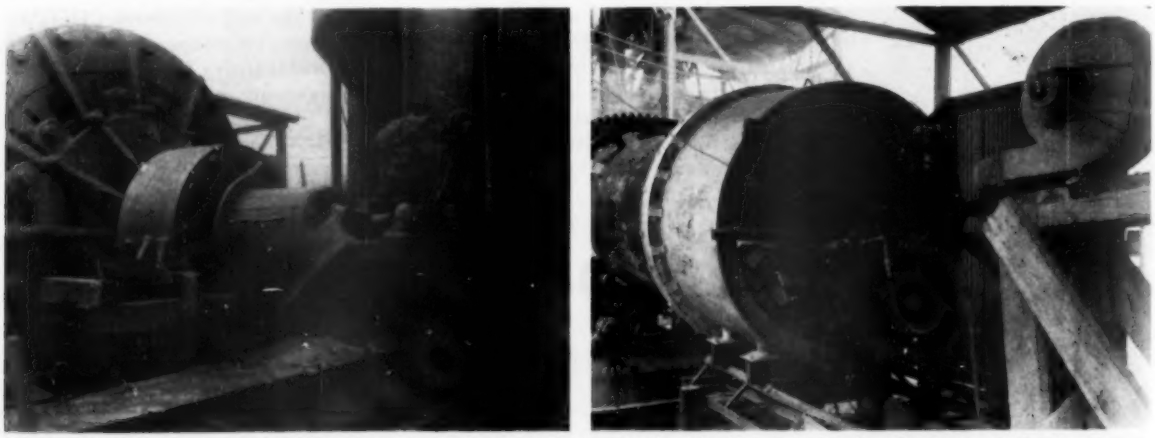
(1) Volcanic ashes and tuffs (including pumicite) of rhyolitic, datic or andesitic composition.

(2) Siliceous sedimentary rocks, such as diatomaceous earth and opaline shales and cherts.

(3) Burned clays and shales.

(4) Industrial by-products, such as blast furnace slag, fly ash and ground brick.

The use of fly ash is a controversial subject, probably stemming from its claimed lack of uniformity. Since fly ash is the ash resulting from burning powered coal, variations in the



Left: A small screw conveyor in the discharge trunnion of the tube mill helps the flow of micron-sized pozzolan. Right: the calcining kiln's burner end is open; natural gas is used for fuel

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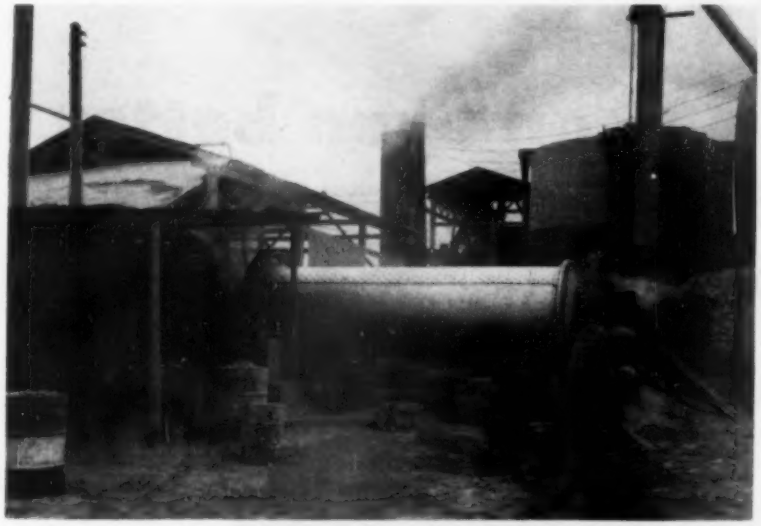

One of the two tube mills used for grinding the pozzolanic material

type, grade and source of coal coupled with variables in the burning conditions evidently can account for some of the claimed non-uniform results obtained by its use.

Over the years there has been a considerable amount of data published relating to the use of pozzolans in concrete and much data related to theoretical discussions of just what reactions take place in concrete when pozzolans are used. Sifting through the details, the information boils down to the fact that when concrete sets, a chemically active lime in some form or another is liberated. If there is a chemically active silica readily available in the concrete for the lime to combine with, a calcium silicate or some complex variation of this compound results. Such silicates that do form are related to the best cementing material in the world—nature's own.

For such recombinations to be effective the pozzolanic material must be in intimate contact with its reactor. This means using an optimum amount, and, equally essential, grinding the pozzolan extremely fine. The optimum amount will prevent the possibility of making too sticky a mix, or raising the water requirements excessively if too much pozzolan is used. Diatomaceous earth is an opaline material, high in silica, and some adhere to its use as a pozzolan, but others who have used it seem to think that if enough of the material is used to be effective, the amount necessary gives the concrete other unwanted properties.

The second benefit that can be derived from the use of a chemically active silica additive is as a corrective for so-called reactive aggregates. Under this theory, some aggregates are said to react with the alkali in portland cement to form a gel. The gel occupies a greater volume than the chemical components with the result that the expansion can destroy the concrete. By the addition of a chemically active and finely ground pozzolan, this reaction is assumed to take place before the concrete sets. Once it does take place the alkalies are automatically neutralized, or destroyed, and no harmful results will occur in the future.

Under this reactive aggregate theory 1½ to 3 percent of the harmful aggregate in the mix is bad—a higher percentage is not considered as harmful. Possibly this can be traced back to the mass of the reacting substance—there being enough area (or mass and time) for most of the alkali to be destroyed.

During the periods of formation of rocks as we know them, the simple silica became transposed into various obsidian-type glasses, opaline rocks, chalcedony, flints, cherts, quartz and quartzite with their chemical reactive properties ranging from what might be considered infinity to zero.

Glasses that cooled quickly, and blast furnace slag similarly cooled rapidly by immersing in cold water are as a rule more chemically reactive than slowly cooling molten rocks—such as the granites and felsite, etc. Copper blast furnace slags, for instance, if allowed to cool slowly on the dump, are insoluble in all acids. If the same slag is cooled in a bucket of cold water, the slag is soluble in a mixture of hydrochloric and nitric acid—all except the silica which remains behind as a transparent silica gel. Now, when the slag was cooled in the bucket of water, nothing was dissolved out of it, nor was anything added. The only change was physical—changes in the slag's molecular structure. In the first case of slow cooling the slag was not reactive. In the second case the slag was made reactive.

It is noteworthy that in the last five to ten years, when discussion relating to this reactive aggregate theory was at its height, only two companies, to our knowledge, have made a material acceptable for correcting concrete's idiosyncrasies. One is a manufacturer of portland cement. The second one is a newcomer to the concrete field—Valley Brick & Tile Co., whose sole business until recently was producing clay brick and similar materials, all essentially competitive to concrete construction.

The company's entry into pozzolan production stems from the fact that it owns many acres of cheaply mined and processed volcanic ash, or volcanic glass—which by its very origin is in the class of rapidly cooled volcanic-source materials, and hence, possibly quite active chemically. The

Raw material is broken up by this disintegrator; a chain drag (left) is used for feeding the unit

beds are up to 100 ft. thick and cover 160 acres or more. It is a soft, partially consolidated, horizontally bedded material. To mine it the operators use a type of cultivator to loosen the surface, after which a small LeTourneau buggy loads and hauls the material to the plant. Two RD-4 Caterpillar tractors are available for the work. The same silica material is used in the manufacture of certain types of brick in the company's plant at Rio Grande City alongside the new pozzolan processing section.

The pozzolan has the following approximate analysis:

SiO_2	70.0 percent
Al_2O_3	16.0 percent
Fe_2O_3	2.5 percent

Small amounts of gypsum are present. It is a light brown material and easily disintegrated.

Plant Operations

The volcanic material is dumped to a hopper and a small drag delivers it to a disintegrator made by J. C. Steele and Sons. While this unit is evidently quite common in the brick industry it is almost a total stranger to the rock products industry. The machine is simply two small rolls, one slightly corrugated and smaller than the other. Material going through it is not only crushed but shredded, due

(Continued on page 200)

Another Vulcan Kiln in Tennessee

REPEAT orders are the surest indication of satisfactory service. In 1928 a well-known Tennessee cement company installed two Vulcan rotary kilns, each 10 feet x 215 feet, for manufacturing Portland cement by the wet process. During nearly a quarter-century of practically continuous operation these two kilns have given, and still give, such satisfactory service that another Vulcan kiln has recently been installed to provide 60% additional capacity.

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Rocky's Notes

(Continued from page 93)

bond with the Ca than the CO_2 radical.

Petrology

The chief theme of petrology is how the various rocks of the earth's crust got to be what they are. This, according to theories, developed from laboratory experiments as well as field observations, involved heating, solution, sedimentation, and combinations of all three. In most instances it is reasoned that the heats involved were of no higher temperature than those used in the manufacture of lime and cement. Consequently the chemical reactions that take place in lime and cement kilns could have taken place in nature under certain conditions. The formation of concrete on the other hand is closely related to the mode of formation of sedimentary rocks. When high-pressure steam is employed, as in the concrete products industry, an entirely different result is attained, related to metamorphic rocks.

The latest and most up-to-date textbook on petrology to come to our attention is "Theoretical Petrology"*, by Tom. F. W. Barth, professor, Geological Museum of the University, Oslo, Norway. In his preface the author states: "Petrological reactions are governed by the same laws in the earth's crust as in the laboratory. It is unfortunate that physics and chemistry were ever separated; they seemed wide apart only when chemistry was largely empirical and non-mathematical. . . . The fundamentals of petrology are embedded in the physical chemistry of rock-making processes. Not until such processes are fully understood can students of geology and mining elicit truth from existing petrological data. Comprehensive information on this subject is not readily available, however; it is rarely taught in advanced university courses, partly for lack of textbooks, partly for conventional reasons. This book is presented to students, teachers, and professional geologists with the hope that it may serve in a minor way to meliorate some of these difficulties."

One fact from this textbook should prove very helpful to all laymen struggling to get a grasp of the modern theories of the structural chemistry of cement and concrete. We have noted a number of times that the earth's crust or lithosphere is some 60-odd percent silica; that is on a weight basis. Silica, as every one knows is SiO_2; but oxygen (O) is the chief component of nearly all other rocks. Thus, oxygen comprises 46.7 percent of the earth's crust on a weight basis. Oxygen, however, is a large atom or ion some 3½ times

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the size of a silicon atom, so that on a *volume* basis, oxygen is nearly 95 percent of the earth's crust. In other words, we can safely think of any rock product as composed chiefly of packed spherical oxygen atoms or ions, with any other elements occupying spaces between the spheres of oxygen. Of course, some of the other elements are occasionally concentrated in veins—that is cracks—in the earth's crust, but for the crust as a whole, it is composed primarily of a network of oxygen ions, which are anions (negatively charged electrically) held together by various cations (positively charged atoms, such as the metals.)

Future Rock Products Chemistry

The thing that intrigues us most about structural inorganic chemistry, such as illustrated in the three textbooks mentioned here, is the tremendous future in recasting nature's minerals to make them more useful to man. The manufacture of lime and cement are good but ancient examples, which judged in the light of practical developments in the field of organic chemistry, must still be considered crude operations. Much more progress has been made in certain divisions of ceramics, such as glass and refractories. The new chemistry of silicones is another example, but it took organic chemists to develop these possibilities of silica as a raw material. Through developments in structural inorganic or mineral chemistry it was learned that the silicon atom, with four positive charges of electrical attraction to dispose of, can, as in silica, occur in chains, sheets and rings like carbon. Hence, scientific reasoning showed that some of these positive charges on the silicon atom could be bonded to hydrocarbons, as well as to oxygen and other elements. Thus silicones are developed, and the end is not yet.

The earth's crust nearly everywhere, like sea water, contains practically all the various elements. Many are rated as scarce only because they occur in fractional percentages. But more and more uses are being found for such scarce minerals as lithium, selenium, germanium, etc. They exist in rocks all around every quarry operation. And lime and cement manufacturers are daily wasting thousands of tons of carbon dioxide, which, dissolved in water or steam to form carbonic acid, is one of the most potent mineral solvents in nature. We may not live to see it, but we anticipate the day when every worthwhile cement and lime operation will be the hub of an extensive inorganic chemical industry.

Installs Dust Collector

BLUE DIAMOND CORP. recently installed a new dust collecting system at its gypsum plant in Blue Diamond, Nev.

Labor Relations Trends

(Continued from page 95)

"The hours of work in the company's plant, as in other similar operations, were reasonably regular from Mondays through Fridays, but were irregular on Saturdays when the week's work would be wound up. Depending upon the volume of business transacted during the preceding five days, the office force might complete its labors for the week within a few hours in the forenoon on Saturday, or it might be required to work all day in order to finish. The policy of the company was to pay its office force for a definite number of hours on Saturdays whether they worked those hours or not. If the office force finished early on Saturdays, the employes could go home and received full pay; on the other hand, if it took the full number of guaranteed hours to complete the week's work, they were expected to work the full number of such hours.

"Had the office employes remained on the job for the full number of guaranteed hours without doing anything, there would be no question as to the legality of the method by which they were paid; furthermore, had the employes been paid only for the hours they actually worked, each one would have received less money than she in fact received under the company's plan.

"The company's method of compensating its employes was not artificial or culpable, nor was it a device to evade the requirements of the Court's injunction or of the Act; on the contrary, it was entered into in good faith and with the intent to comply with the letter and spirit of the injunction and the Act, and respondents have always believed that it did comply with said injunction and statute.

"As stated, the payroll records of the nonexempt office employes do not, in cases, reflect the actual hours worked by the respective employes in a given work-week, and in this respect said records are technically inaccurate and do not comply with the injunction. The inaccuracies, however, are trivial, and they deceived and prejudiced no one. All of the office employes worked at one time or another on said records and knew how they were being kept and how their compensation was computed. Said records are now being properly kept and maintained.

Criminal Contempt

"With respect to the charge of criminal contempt against the company, there is no evidence indicating that the company, or its officers and employes consciously violated the Fair Labor Standards Act or the injunction or that it or they wholly disregarded the law or the injunction, or pursued their course of conduct without making any reasonable effort to determine whether or not it constitute a violation of the law or of said injunction. Nor is there evidence that the company, its officers and employes have intentionally or purposely, or obstinately disregarded either the law or the injunction, or that it or they have been plainly indifferent to the requirements thereof. Therefore, it cannot be said that any violation of which the company may have been guilty was wilfull.

"On the other hand, the Court finds that at all times since the entry of said injunction the company and its officials have been keenly aware of the requirements thereof and of the Act, and conscientiously endeavored at all times to comply therewith, and, in our opinion, have done so with minor exception relating to the records which has been heretofore noted. Furthermore, respondents immediately and fully complied with every recommendation made by the investigator for the Wage and Hour Division in the course of his said investigations with respect to records and otherwise, including the purchase and installation of a time clock.

"The Court further finds in this connection that in December, 1951, the company had in its employ 99 employes, of which number five were employed in nonsupervisory clerical positions in the office. The Court further finds that in the years from 1942 to 1950, inclusive, the company had in its employ a minimum of 55 employes and a maximum of 120 employes in December of each of said years, and that there were employed in the office in nonsupervisory clerical positions from one to six employes. In December, 1951, the clerical employes in the office had a total weekly payroll of approximately $310 and the total plant payroll was $5800. These figures demonstrate the triviality of the violations alleged against the respondents and in the Court's opinion, negative the idea of wilfulness on their part.

"The petitioner [the U.S. Labor Department] has expended in investigation and prosecution of civil contempt the sum of $400.

"The company has operated under the shadow of this injunction for almost 10 years, and for nearly nine of those years no investigation of its operation was made; during that time it conscientiously undertook to abide by the law and the terms of the injunction, and during said period of time relations between the respondent and the nonexempt office employes were good, the latter being fully compensated for their work and being treated with a kindness and consideration, a continuation of which, in certain respects at least, may have been rendered impossible by the petitioner's [Labor Department's] attitude in this case.

"When the respondent's plant was investigated in June and August of 1951, the only practices found to be questionable were the method of pay-

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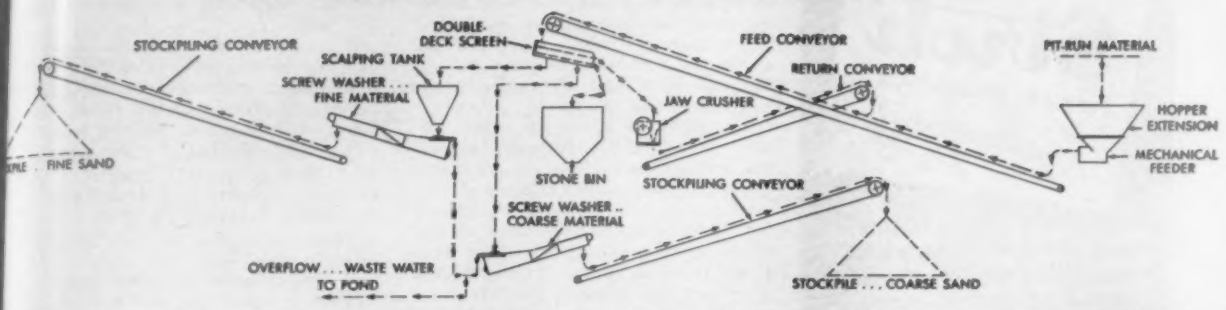

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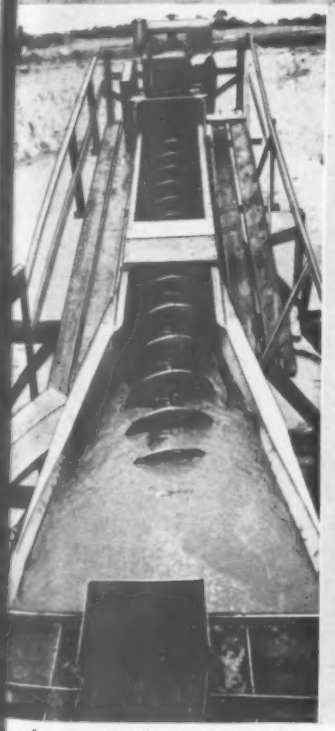

-up of screw washer for coarse material

Return conveyor provides closed-circuit operation

View of settling tank and screw washer for fine materia

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BALDWIN BLH LIMA-HAMILTON

SINCE 1859—BUILDERS OF CONSTRUCTION EQUIPMENT

ing the office employes, which has been mentioned, and the method of keeping the time and records of these employes; as pointed out, said employes make up only a small portion of the total number of employes of the company, and the amount of underpayments alleged by petitioner is insignificant compared with the total payroll of the company. Despite the trivial nature of the alleged violations, the co-operative attitude of the respondents [the company] and all efforts made by the president of the company to convince the Wage and Hour Division of the innocence and good faith of himself and his company, which included a trip from his office to the Division's office in a distant city, the Division insisted upon filing the instant proceedings and requiring the respondents to stand trial for both criminal and civil contempt; the charges of criminal contempt have completely broken down against all of the respondents, and the charge of civil contempt has been sustained only on the most technical grounds and only in the one respect which will be mentioned in the Court's conclusions of law. Yet these proceedings, largely unjustified in the Court's opinion, have caused the respondents unmerited adverse publicity as well as trouble, worry and expense incident to defending the case.

"The Court is satisfied from the testimony herein and the attitude, manner, and demeanor of the officers and employes of the company that there is no reason to believe that future violations of the Act will occur at this company's operation, and in the Court's opinion it would be, under the circumstances, unjust and inequitable as well as unnecessary to retain the injunction in force any longer, and that it should be dissolved.

Conclusions of Law

"(1) The Court has jurisdiction of this cause and of the parties thereto.

"(2) The charge of criminal contempt against the company will be dismissed.

"(3) Under the circumstances set forth in our findings of fact, the methods used by the respondents in compensating the nonexempt office employes was not in violation of Section 7 of the Fair Labor Standards Act, or of any other provision of the Act, or of any injunction of this Court, and did not result in underpayments to such employes.

"(4) All of the respondents are in civil contempt, in that time and payroll records kept for the nonexempt office employes of the company do not in all cases correctly reflect the hours actually worked each week by each of such employes.

"(5) In order to purge themselves of their civil contempt [the two principals] will each be required to pay a fine of one dollar. In order to purge itself of civil contempt the company will be required to pay a compensory fine of $400 to reimburse petitioner for the expense of investigating, instituting and prosecuting this case.

"(6) Upon the respective respondents purging themselves of their civil contempt, as aforesaid, the injunction heretofore entered by the Court will be vacated, dissolved, and set aside."

The case was that of U.S. vs. Little Rock Packing Co., U.S. District Court of Eastern District of Arkansas Cr. No. 15299, February 27, 1952.

There remains a mystery the answer to which only God, possibly the U.S. Department of Labor and the unknown writer of the anonymous letter could answer. Was it from a disgruntled female ex-employe or from a competitive concern?

Vermiculite Meeting

THE VERMICULITE ASSOCIATION, INC., held its annual meeting, June 24, 1952, at the Hotel Astor, New York, N.Y.

William S. Steele, president, American Vermiculite Corp., was re-elected chairman; Henri R. Bastien, president, Vermiculite Insulating, Ltd., Montreal, and N. M. Bernier, president, California Stucco Products of N.E., Inc., Cambridge, Mass., were elected vice-chairmen; and William S. Elliott, secretary-treasurer. John W. Lewellen, Jr., Hyzer & Lewellen, Southampton, Penn., and N. M. Bernier were re-elected to full terms on the board of directors.

Achievements for the past year, which included column fireproofing with Underwriters' Laboratories and municipal approvals, as well as the adoption of the association specifications for vermiculite concrete roof-fill, were reviewed.

New bulletins covering specifications and working directions for concrete floor fills and cold storage insulation, and recent acoustical tests, resulting in a noise reduction coefficient of 0.60 for acoustical plaster were approved for release.

Reinforced roof plank for spans up to 7 ft., utilizing varying formulas which have produced compressive strength results up to 2430 p.s.i., were discussed and it was decided the program should be continued for the coming year.

Other projects to be carried out in the ensuing year include the continuation of comparative checks of the characteristics of South African, Montana and Carolina crude vermiculite ores for use in the fertilizer and horticultural fields; continuation by the engineering staffs of individual job inspections and supervision of member plants; a comprehensive survey of transit and central mix types of concrete mixing equipment, for the purpose of developing detailed specifications and mixing instructions for each type; and an increase in publicity and contact with related organizations is planned.

Crushing Practice

(Continued from page 168)

tion of this machine compares favorably with that of other types, the rather violent fluctuation outlined and the relatively high connected horsepower are unfavorable features. It is also natural to expect that the belt slippage we have noted would constitute something of a problem over a period of time. Performance records indicate that belt trouble accounts for about 50 percent of the total lost time on a set of these rolls, and about 25 percent of the total maintenance expense.

The type of quarry equipment most commonly used in conjunction with this crusher is the three-sided steel skip, carried on a flat-top truck or flat car. These skips are provided with a shackle on the rear end, which is engaged by a hook actuated by a small hoist. This apparatus slides the skip over against the lip of the receiving hopper, and tilts it to discharge its contents. The skips discharge over a feed-roll which retards the flow of material so that the entire load does not drop into the crushing chamber at once. When the skip is empty it is pulled back on to the truck or car by a counterweight attached to the opposite end of the same cable which performs the hoisting operation.

We have mentioned the heavily ribbed hopper which surmounts the frame and extends up to the level of the feed roll. This hopper serves the double purpose of directing the material into the crushing zone, and preventing stones thrown by the slugger teeth from flying out of the crusher. It is also necessary to cover the top of the hopper with heavy netting to contain flying spalls.

The straight-sided, rectangular hopper construction, and the violent agitation in the crushing chamber, tend to minimize blocking and bridging in this crusher. When bridges do occur they are difficult—and dangerous—to break while the rolls are running.

Applications

Practically all that we have had to say about the application of the single-roll crusher will apply as well to the Edison roll crusher. It is better adapted to handling blocky stone than is the single-roll machine, because its slugging action is much more vigorous, and it will handle any material that will not build up on the sides of the vertical hopper. It is not as simple a machine to feed as the single-roll crusher, because its narrow hopper necessitates the uses of skips, or very short-bodied cars. A heavy-duty apron feeder would of course solve this problem, but so far as we know, none of these crushers were so equipped.

The very high peak capacity of the crusher constitutes something of a problem in plants of medium capacity. It is not economically feasible to provide elevating or conveying equipment to handle peak loads of around 400 t.p.h. in a plant designed to turn out that much stone in an 8- or 10-hr. day; consequently means must be provided to smooth out these high surge loads. This can be taken care of by a surge bin and feeder below the crusher, or by passing the roll product direct to a secondary crusher of uniform-capacity characteristic. A feeder ahead of the rolls would smooth out peaks on mixed feed but, once a 10- or 12-ton block of stone is dropped into the crusher, that quantity comes through very quickly as crushed stone, which would render the regulating properties of the feeder of questionable value.

Modified forms of this crusher were used by Mr. Edison for secondary and tertiary stages. The crushing equipment in one large plant, for example, comprised a set of 6- x 7-ft. rolls (8-in. product), a set of 4- x 4-ft. secondary rolls (3½-in. product), and a set of 4- x 3-ft. tertiary rolls (1½-in. product), these last rolls being in closed circuit. These smaller machines were also run at high speeds, their surface velocities being slightly over 3000 ft. per min.

Light-Duty Roll Crushers

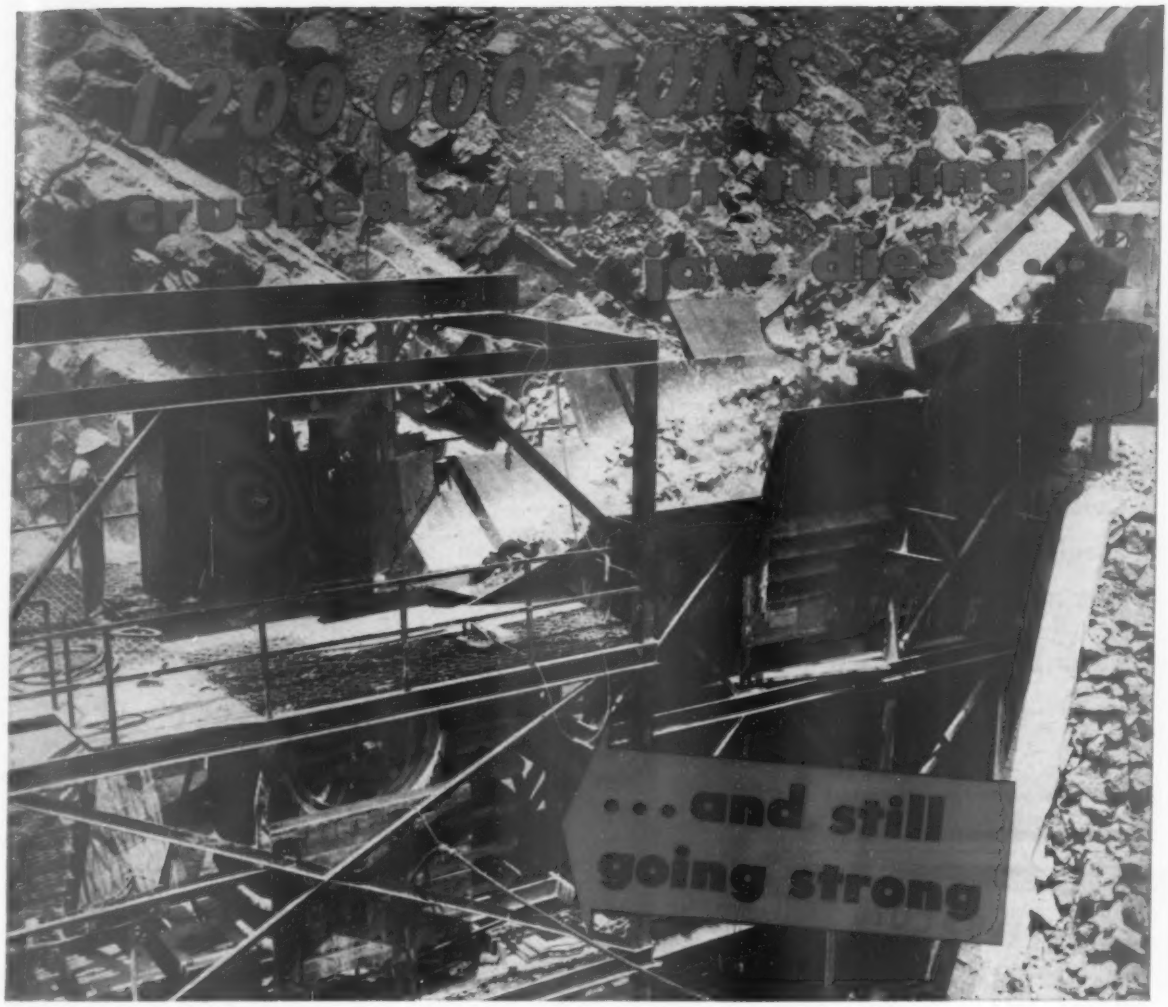
Both single- and double-roll crushers have been extensively developed for crushing coal, coke, shale and similar soft and friable materials. These machines resemble in general form the roll crushers we have described, but they are of course much lighter, and their mechanical details are correspondingly simplified. Instead of the knob-like teeth used on the stone-breaking rolls, these coal crushers are usually fitted with spike-shaped teeth, and the action has more of a tearing nature rather than the heavy slugging and sledging that takes place in the Fairmount and Edison types.

To simplify the drive, double-roll coal crushers are usually geared together, which works out quite satisfactorily because the shocks in machines of this type are light, as compared to those in stone-breaking rolls. This same practice, incidentally, was followed in the earlier, and lighter, rolls used on stone and ore; it is not used in any of the present-day heavy-duty double rolls. Single-roll coal crushers are driven by the same gear-and-pinion arrangement used in single-roll stone crushers. Peripheral speeds range from about 400 to 800 ft. per min., the double-rolls usually running at higher speeds than the single-roll machine.

(To be continued)

●

HALLET CONSTRUCTION CO., Crosby, Minn., is setting up a sand and gravel plant near Crosby, to furnish aggregate for the paving of Highway 105. Stripping of surface soil and clay has been completed and a dragline, washers and other equipment are being installed.



This Lippmann GRIZZLY KING Jaw Crusher at Alabama Aggregate Company, Pelham, Alabama, has crushed 1,200,000 tons of tough Blue Ridge rock since it was installed. Discharge opening is 5 inches. The management reports that this tremendous output has been attained without interruptions — that the reversible jaw dies have not been touched, not even reversed.

No other jaw crusher can match GRIZZLY KING'S capacity and performance. Extra-long curved and reversible jaw dies, engineered crushing action with alloy steel frame and jaw add up to the rock-eatingest crusher on the market today. The GRIZZLY KING is the world's highest capacity overhead eccentric jaw crusher and is available in sizes up to 36" x 48" opening.

Other Lippmann equipment at Alabama Aggregate includes an apron feeder and discharge belt conveyor with Lippmann Life-Sealed Ball Bearing Idlers. Leading operators the world over choose Lippmann for their crushing, screening and washing plants both stationary and portable. It will pay *you* to do so too. Lippmann Engineering Works, 4605 W. Mitchell St., Milwaukee 14, Wisconsin.

LEW LIPPMANN

CRUSHERS FEEDERS SCREENS CONVEYORS CRUSHING & WASHING PLANTS

Marquette's New Plant

(Continued from page 131)

Bulk Cement

Bulk loading is done at the rate of 500 bbl. per hr. into cars from two divided bulk loading tanks of 800 bbl. total capacity.

The 8-in. rail-mounted F-K pumps underneath the silos deliver into a 5-ft. dia. overhead deaerator vented by a 2100-c.f.m. Sly dust arrestor and the cement may be discharged into either compartment of the bin. Cement is loaded from the tanks through Air-slides and both may be drawn from simultaneously in loading a car. The cars are loaded on a track scale and the weighman controls the loading.

Electrical

Laid out for a balanced power load, the plant has a maximum demand factor of 3000 kw. (day and night), power being purchased from the Mississippi Power and Light Co. Cement is being produced at a power consumption of 20 kw. per bbl., including all operations.

Power is brought in at 110,000 volts and stepped down to 4160 volts for the larger horsepower motors. The main power distributing station is an independent motor room adjoining the mill building where the room is under slight pressure to keep out dust. Electricity is brought in here at 4160 volts. All grinding mills are arranged in a row so that their shaft connections are to synchronous motors located within the main power station and completely away from mill room dust. Power is distributed, at 4160 volts, to four unit stations located at the packhouse, the main transformers, the blending tanks and at the front end of the kiln building, respectively. These substations transform the power to 440 volts. Unit boards with starting switches and signals are spotted at various plant locations for the convenience of the operators. Air-actuated across-the-line starters are used exclusively. Motors of 200 hp. or less are supplied 440-volt current and the stepdown is to 230 volts for many of the small motors. Distribution is through underground Transite conduit.

One of the main features of the electrical system is the interlocking of the drives for related equipment whereby, in the case of the entire wash mill, or the clinker grinding department, for example, stoppage of a unit of equipment will automatically cut out the equipment ahead while the equipment beyond will continue operating until its supply of feed is exhausted. Feeders to the grinding mills are interlocked so that a starvation of feed to one will cut out the others.

Synchronous motors are of the start-under-load type and are of 80 percent leading power factor characteristic to hold down losses as compared to unity power factor motors. Starters for the big motors are centralized in the main motor room. All electrical equipment including switchgear and motors is of Westinghouse manufacture. Falk gears are used throughout on the drives for major equipment.

Water is supplied from a 1600-ft. well and delivered at the rate of 375 g.p.m. by a Layne turbine pump into a supply tank. The pump house also has two Pomona turbine pumps and a Fairbanks-Morse fire pump.

Engineering-Supervision

Jens Holm, director of engineering of Marquette Cement Manufacturing Co., designed the plant. Crosby Engineering Co. handled design details for the various buildings and some of the mechanical detailing, subject to approval by Mr. Holm.

William Moyle is superintendent of the plant and Sam Webb is chief chemist. Mr. Moyle came to Brandon from the company's plant at Nashville, Tenn., and previously had seen service at other mills of the company, starting with the Oglesby, Ill., operation. Mr. Webb came from the Des Moines, Iowa, plant and is responsible for the blending control system.

Officers

Frank Moyle, recently elected a vice-president of the company, has been director of operations for many years. J. H. Howe is assistant director of operations and C. E. Wuerpel is technical director.

W. A. Wecker is president of the company; D. S. Colburn, executive vice-president; S. L. Cribari, vice-president; L. W. Saxby, vice-president; W. W. Dickinson, vice-president; V. J. Hanley, vice-president and secretary-treasurer; and Stuart Duncan is chairman of the board of directors.

With completion of the Brandon plant, Marquette now has an annual rated capacity of 10,650,000 bbl. of cement. Other producing plants are located at Oglesby, Ill.; Cape Girardeau, Mo.; Des Moines, Iowa; Nashville, Tenn.; and at Cowan, Tenn. Packing and shipping plants are located at St. Louis, Mo., and at Memphis, Tenn., where a large capacity sand and gravel plant is also located.

Cement and Gypsum Plants

THE PROVINCIAL GOVERNMENT of Newfoundland has undertaken the development of a cement mill and a gypsum wallboard and plaster lath plant, as recently reported in *Mining Engineering*. Previously, an annual consumption of some 200,000 tons of cement was supplied by production from Quebec, Ontario and imports from Europe. The cement mill's annual capacity of 100,000 tons will help ease the province's chronic shortage.

The gypsum wallboard plant, now about to be brought into production, will have a capacity of approximately 250,000 sq. ft. of board per day.

4-wheel drive PAYLOADER®

Palmetto Quarries takes tons of tough, stubborn granite from its Columbia, South Carolina quarry. With two large electric shovels and a fleet of 15 ton trailer trucks to keep moving, there are lots of chores for its 1½ yd. Model HM "PAYLOADER" tractor-shovel . . . there's clean-up around the shovels, starting and pushing stalled trucks, building and maintenance of roadways, loading odd lots of rock, cleaning-up around conveyors, and many other jobs.

This 4-wheel-drive "PAYLOADER" replaced a big crawler tractor and the management cites the following benefits: (1) does all the work the tractor did (2) gets around faster (3) shows savings in operation cost over tracks (4) provides an additional loading tool and (5) the tractor operator is much happier.

Model HM's are helping quarry and pit operators all over the country to increase production and reduce costs. You are invited to find out how "PAYLOADERS" can help you too. The Frank G. Hough Co., 705 Sunnyside Avenue, Libertyville, Illinois.

WRITE for catalog on the 1½ yd. Model HM or the six other sizes of "PAYLOADERS" down to 12 cu. ft. bucket capacity. There's no obligation.

SAY "HUFF"

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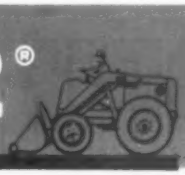


German Cement Association Celebrates 75th Anniversary

THE 75TH ANNIVERSARY of the founding of the German Portland Cement Association was celebrated during May in Dusseldorf, Germany, with a meeting at which a number of technical papers were presented. Dr. Haegermann reviewed the history of the association. Elected to honorary memberships were Prof. Graf of Stuttgart, Dr. Kneisel of Hannover, Prof. Kuehl of Berlin-Lichterfelde, Director Mundhenke of Beckum, Prof. Nacken of Tubingen, and Dr. Wirtz of Bad Pyrmont. Highlights of some of the papers presented are given here.

Prof. Nacken presented a paper on "Setting, Hardening and Unsoundness." During the hydration of cement, crystalline phases can be prepared readily enough hydrothermally, but at low temperatures the hardening processes are much more difficult to determine. The clinker in contact with water becomes unstable and tends to establish a new equilibrium. Unsoundness of cement has been shown to be due to hard burned lime or magnesia, which on hydrating cause volume increases.

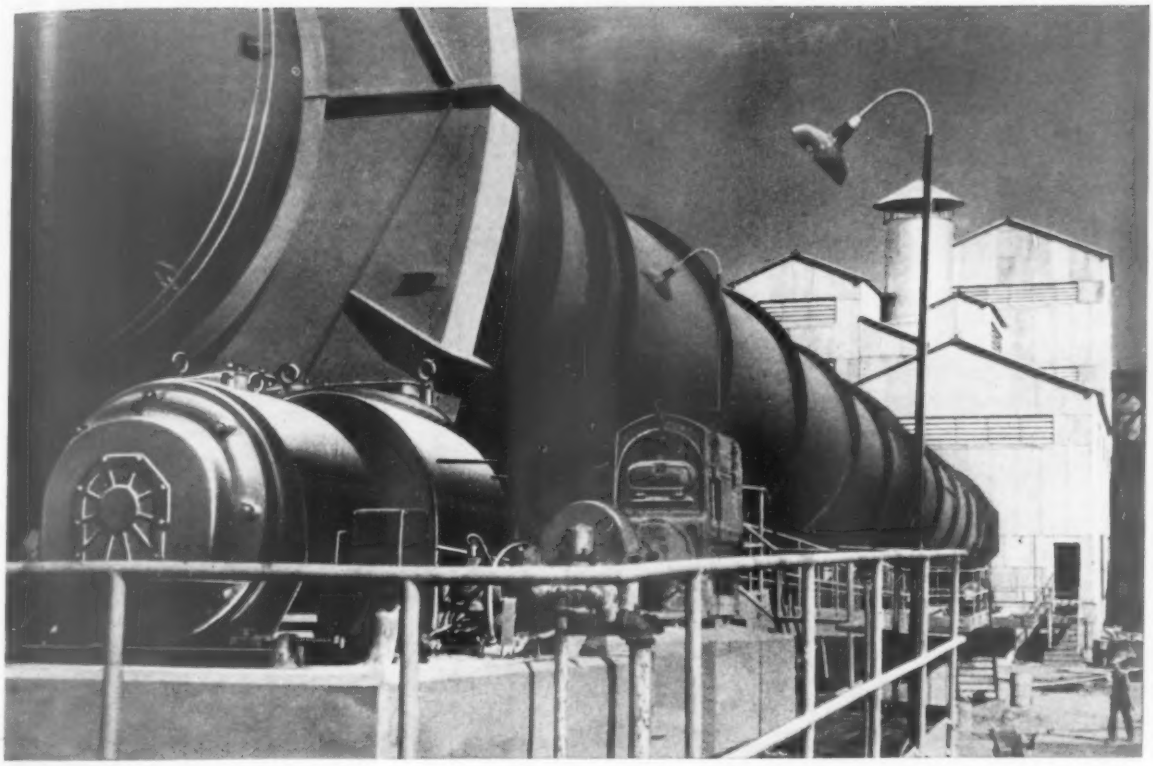
"Ease of Sintering of Raw Mixes" was the subject of G. Mussgnug. He found that the ease of sintering depends chiefly upon the silica-alumina ratio. This relationship was first studied with pure ingredients and then with different raw mixes in order to study the effects of various admixtures. The fineness of the raw mix was also found to be a very important factor.

Dr. G. Troemel of Dusseldorf spoke on the topic "High Temperature X-Ray Studies of Calcium Silicates and Cement Clinkers." Owing to the tendency of dicalcium to transform into different modifications, it was necessary to make a complete revision of previous research, the speaker prefaced. X-rays taken at temperatures as high as 1700 deg. C. permit determination of the formation of mixed crystals at high temperature and their transformation during cooling. Such methods, it was stated, permit more exact study of cement reactions.

Dr. F. Gille discussed "Magnesia in Clinker and Its Effects on Autoclave Tests." Observation of periclase under the microscope is made much easier with thin slides. Small test specimens can be used for observing the expansion in an autoclave. This expansion is not necessarily directly dependent on the MgO content. Some of the periclase crystals react very rapidly with steam under pressure while others react much more slowly, probably because of mixed crystal formation. Degree of expansion of periclase when steamed also depends upon the grain size. Very fine grains make possible reduction of the autoclave expansion. By adding quartz, trass or blast furnace slag in sufficient quantities, a clinker high in magnesia can be made which will stand up in the autoclave test.

Dr. E. Schott of Heidelberg described production experiments with cement kilns. An experimental study was made on the following equipment and fuels: three waste heat boilers, two wet process rotary kilns and attached calciner, one Lepol kiln, one shaft kiln with different types of coal, one shaft kiln with different size briquets or nodules, one type of coal of different sizes, one sintering grate and one rotary kiln having a heat exchanger. The waste heat rotary kilns had a very favorable heat requirement, running from 860 to 1050 k.cal. per kg. clinker. The wet process rotary kiln and calciner required the most heat, although the calciner showed a saving of about 500 k.cal. per kg. after installation. The Lepol kiln required 966 k.cal. per kg. of clinker. Surprisingly enough, the speaker said, it was found that crude brown coal up to 30 percent could be used without reducing the output or the heat requirement. The briquets or nodules don't seem to require a critical sizing. The sintering grate has relatively high heat requirement, although some saving can be effected by abstracting heat from the waste gas. It is possible with suitable ventilators applied to the grate to raise the yield to 400 t.p.h., it was pointed out. The heat exchanger gave very good results, the greatest advantage being that a dry raw mix can enter the kiln at about 800 deg. C.

"Open Circuit and Closed Circuit" was the subject of H. Boerner of Goslar. The air separator has demonstrated its usefulness for raw mix or coal grinding. However, serious doubts have risen over its application for cement grinding, the speaker said. In the slag-cement plant at Watenstedt, a comparison was made between a single compartment mill and a three compartment mill of the same size and with closed circuit grinding. This would seem to present an ideal opportunity for comparison, Mr. Boerner said. However, after three months of operation of the five basic variable factors, only one, the closed circuit with three compartment mill, could be determined completely. The clinker and blast furnace slags have appreciably different grinding characteristics and thus have provided interesting studies. The Blaine values and strengths can only be properly interpreted with reference to the relative grinding characteristics. With the compartment mill the sieve residues and the Blaine



Another Dynamatic "FIRST"

Dynamatic eddy current rotating apparatus has been used for many years in a wide range of industries for better speed control, quality control, and minimum operating costs.

This universal acceptance has now been extended to include the cement industry at the new Penn-Dixie Cement Plant recently put into operation at Kingsport, Tennessee.

A Dynamatic model 10W liquid cooled coupling driven from a 350 H.P., 514 R.P.M. synchronous motor, drives the induced draft fan to handle all the air through the kiln. A model 8W liquid cooled coupling is used for the main kiln drive and is driven by a 200 H.P., 1200 R.P.M. cage motor. Small Dynamatic air cooled couplings are used on the synchronized slurry feed drive, the cooler drive, and the coal feeder drive.

The large liquid cooled couplings and all auxiliary drives are simultaneously controlled by heavy duty dust-tight industrial electronic controls arranged with automatic transfer switches to insure continuous operation and accurate speed regulation.

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Ausco-Spedes • Shovel Clutches • Press Drives • Lift Truck Clutches • Electronic Controls

values can not be correlated because of the useless overgrinding of the more easily ground slag. The air separator must receive more study to establish the optimum yield when a mixed feed has to be ground, the speaker concluded.

Dr. F. Keil of Dusseldorf presented a paper on "Experiments with Concrete Admixtures." During the hardening of cement, chlorides generally act as accelerators, while sulfates and phosphates are retarders. Chlorides also increase strength, as a rule, whereas phosphates are apt to be quite harmful. To improve the durability of concrete it has been customary to try to secure as favorable a grading of the aggregate as possible in order to produce maximum density. It is also desirable to limit the water-cement ratio and to control the pore space insofar as it results *from* air-entraining agents, according to the speaker. This has been proved by freezing experiments, he said. An interesting example given was that of a reinforced concrete pier which has seen 30 years of service in the North Sea without perceptible disintegration. It was suggested that the usual laboratory testing for an aggressive solution may not give a definite measure of the probable durability of the concrete.

Prof. B. Wedler of Berlin talked on German building specifications, presenting a review of their history and of their evolution. There are now more than 800 specifications, many outdated and unsuitable for modern buildings.

Motion pictures were shown by Prof. Pistor of Heidelberg to illustrate his talk on "Modern Reinforced Concrete." Prestressed concrete progress was covered in considerable detail.

Power Equipment Show

THE 20TH NATIONAL EXPOSITION of Power and Mechanical Engineering will be held in Grand Central Palace, New York, N.Y., December 1-6, 1952. Major improvements in power equipment will reflect a marked trend toward the fully automatic generating station. The automatic power plant is recognized by the engineering profession as a basic element in design, and future plants are being planned from the beginning as completely integrated units. Many new exhibits at the power show will disclose innovations designed to fit advanced concepts of the unified power plant.

The American Society of Mechanical Engineers, under whose auspices the exposition is being held, will hold its annual meeting during the week of the show. The exposition is under the management of the International Exposition Co., with permanent headquarters in Grand Central Palace. Charles F. Roth is manager of the exposition and E. K. Stevens is associate manager.

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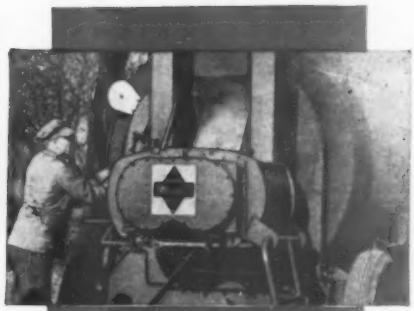
Think of what you could do with the new B-G Mixall in your territory. Then see the Mixall at your first opportunity . . . or write for full information.

THE ONLY SMALL JOB MAINTENANCE MIXER WITH...

- **ROTARY DRUM DRYING: The same principle used in largest B-G Continuous Dryers.**
- **TWIN SHAFT HEATED PUGMILL: "Kneading" action assures even coating of every aggregate particle.**
- **POWER SKIP HOIST: Only 14" high for easy charging.**
- **HIGH DISCHARGE: Can discharge directly into place, into wheelbarrows or gas buggies.**



For parking lots, factory floors . . . on-the-job drying of aggregates, complete control of mix.

BARBER-GREENE COMPANY

AURORA, ILLINOIS

Producing Pozzolan

(Continued from page 178)

to the different peripheral speeds of the rolls. The unit is small, the large roll being about 14 in. in diameter with a 10-in. face.

The disintegrated clay is fed into two 30-ft. long kilns and quickly calcined to 1000-1800 deg. F. This not only drives off moisture but is said to make the material still more chemically active. The calcined material is next picked up by a small front-end loader and hauled to outside storage for cooling.

After cooling, the material is dumped to two hoppers serving feeder belts that deliver to two tube mills. One tube mill is 6 x 20 ft. and the other is 6 x 14 ft. One is an Allis-Chalmers and the other is an Abbe unit. The mills are driven by a Buda gasoline engine. They carry a charge of ¾-in. dia. grinding media. The ground pozzolan from the tube mills falls to a

The small wagon and tractor at left are used for digging and hauling the raw material. Tractor and cultivator at right are used for loosening material

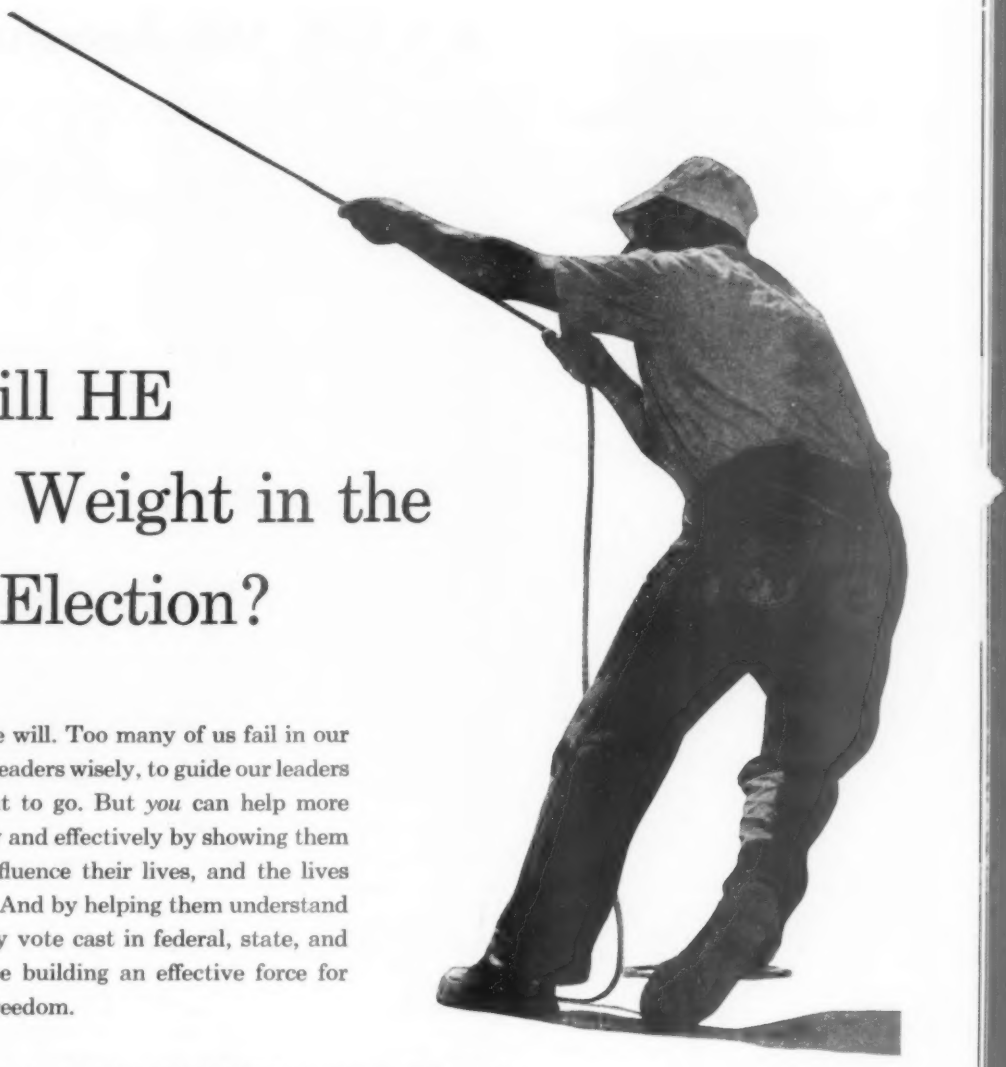
common screw conveyor and to a bucket elevator serving a horizontal cylindrical storage bin from which bulk haulage trucks deliver the material to the Falcon dam construction site.

The material in the tube mills appears to be somewhat flocculated and at times does not discharge readily from the mill, so the operators have rigged up a small screw conveyor that fits into the discharge trunnion of one of the tube mills to facilitate the flow of the ground pozzolan.

The plant is built entirely of used equipment as Valley Brick and Tile Co. preferred to feel its way along in this industry until such time that the value of its pozzolan can become more generally known. However, in the use of this type of equipment no sacrifice in quality was made.

The deposit is one of a dozen or more that was tested by the Bureau of Reclamation and determined to be most satisfactory from a quality standpoint and from the standpoint of economy. Natural gas, which is plentiful in the area, is used for fuel.

Guenther Weiske is president of Valley Brick and Tile Co., Rudy Nordmeyer is secretary-treasurer, and S. K. Barrett is pozzolan plant superintendent.



Will HE Pull His Weight in the Next Election?

It is not certain that he will. Too many of us fail in our duty to vote, to choose leaders wisely, to guide our leaders *in the direction* we want to go. But *you* can help more people vote intelligently and effectively by showing them how their votes can influence their lives, and the lives of generations to come. And by helping them understand the importance of every vote cast in federal, state, and local elections, you'll be building an effective force for political and business freedom.

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1. "THE MAN WHO WOULDN'T QUIT"—to help give people a better understanding of their individual vote and what it can mean to community growth, good government, and prosperity. This colorful, new 16-page booklet follows the time-proven "comic book" technique... dramatizes the relationship between civic responsibility and the ballot.

THIS BOOKLET HAS BEEN TESTED in our own plants by The Psychological Corporation . . . and *proven effective* in changing people's attitudes. Because good government is everyone's business, Bemis is making "THE MAN WHO WOULDN'T QUIT" available for distribution to your people at nominal cost—$10.00 for 100 copies, down to 3¢ per copy in larger quantities.

2. "YOUR VOTE IS VITAL"—A pictorial booklet showing the factors that help a citizen become an intelligent voter — how to understand political issues; how to compare candidates' promises with their records; how to study local issues; how to register; how to vote by machine or ballot, etc. A useful booklet that will help YOUR employees. Costs even less than "THE MAN WHO WOULDN'T QUIT."

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A. S. T. M. 50th Anniversary Meeting

THE FIFTIETH ANNIVERSARY meeting of the American Society for Testing Materials was held in New York City, June 23-27. In Committee C-1 on Cement, the sponsoring subcommittee on masonry mortars has proposed an autoclave expansion limit on the neat cement of 1 percent at 48 hr. This proposal has been sent to members to reply by letter ballot. It has been felt by some that this limit is rather low and unfair to certain materials which have had a great many years of satisfactory performance in the field.

One regular session was devoted to "Features Affecting the Durability of Concrete." Prof. C. H. Scholer, Kansas State College, presented a general discussion pointing out that of the numerous potential factors affecting durability, only a few have received much attention. Hardened concrete is strong but does have some elasticity as well as some plasticity. It is subject to thermal and moisture movements and the air and moisture voids play important roles. These movements are usually rather slow and the plastic character of the concrete aids in making adjustments of great importance in maintaining its integrity. Professor Scholer, after long experience, has generally found little difference in durability among the different cement types. In his experience the combination of the cement and fine aggregate is an extremely important factor. Sulfate attack on tricalcium aluminate in the cement has given much trouble and some sands have unfortunately been found with a high magnesium sulfate content. Bond failure due partly to differential coefficients of thermal expansion, as well as moisture movements, have been noted. A great deal more study is needed before all these complicated factors are thoroughly understood.

C. A. Vollick and E. I. Skillman of the U.S. Bureau of Reclamation have correlated the sodium sulfate soundness of coarse aggregate with durability and compressive strength of air-entrained concrete. The durability of concrete correlates with the results obtained from the sodium sulfate test of the coarse aggregate. However, other factors also take part. With 4 percent entrained air and a water-cement ratio of 0.51, durable concrete could be obtained with coarse aggregate having a loss as high as 32 percent in the sodium sulfate test. The cement content of air-entrained concretes of a given water-cement ratio did not seem to have much influence on resistance to freezing and thawing. On the other hand, the compressive strength was influenced by the cement content and upon the soundness of the coarse aggregate for a given water-cement ratio.

H. K. Cook of the Waterways Experiment Station, Corps of Engineers, spoke on experimental exposure of concrete to natural weathering in marine locations. These locations were in Maine and Florida. At the former, very high tides subjected the specimens to rapid freezing and thawing and a minimum amount of entrained air was required to give durability. If the aggregate was unsound, entrained air was not effective in making durable concrete. In Florida, the chief deterioration resulted from sulfate attack on tricalcium aluminate, the amount of which should be kept below a certain maximum. Entrained air did not seem to help much in resisting such attack. An absorptive form lining was beneficial in improving the durability of the concrete surface.

S. B. Helms and W. J. McCoy, Lehigh Portland Cement Co., Allentown, Penn., presented results obtained at the Lehigh Cement Laboratory after ten years of natural exposure of concrete to the weather. The modulus of elasticity was determined at intervals. It fell off generally in winter, but came back up in summer. The leanest concrete (4.5 bags per cu. yd.) underwent surface disintegration during the first winter, while with a cement factor of 6, it took 10 years to produce similar results. Great care was taken but the results would seem to indicate that certain factors remain which are not appreciated at present and which must be identified and brought under control before the complete story can be told.

A. D. Conrow, Ash Grove Lime and Portland Cement Co., Kansas City, Mo., has made extensive studies of the interaction between portland cement and the fine aggregates common to the Great Plains region of this country. The unsoundness resulting seems to correlate chiefly with the lime available for the reaction, the other alkalies in the cement seeming to have a catalytic effect. The method used was to give an initial heating as high as 160 deg. F., which expansion was noted after storing 120 days at 70 deg. Certain pozzolans were found which were able to control the expansion when added in the ratio of one part to two of cement.

In the session devoted to concrete, Dr. McBurney of the National Bureau of Standards discussed cracking in masonry caused by expansion. Strain gauge measurements of brick panels laid with mortar containing dolomitic lime were given. It was maintained that the bulk of the so-called "shrinkage" in mortar joints resulted from the technique of the mason. Some of the troubles experienced by a parochial school built near Bode, Iowa, were described. In the discussion, C. E. Wuerpel, Marquette Cement Mfg. Co., Chicago, Ill., showed some slides of a job in Madison, Wis., where the same cement had been used.

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Messrs. Mielenz, Greene, Bent and Geier of the Bureau of Reclamation proposed a "Method for Alkali Reactivity of Pozzolans," which consisted of adding to 4.0 g. of pozzolan, 1.5 g. of calcium hydroxide and 25 ml. of 0.5 *N* sodium or potassium hydroxide. After shaking for 48 hr., part of the solution was titrated for alkalinity and analyses were made for Na, Al and Si. The sodium in solution may be reduced as much as 80 percent. The chief compounds formed are calcium silicates. Certain opaline materials and a pumicite were found to be quite active. A reduction in alkalinity of 200 milliequivalents per liter was suggested as a suitable criterion.

David Wolochow of the National Research Council (Canada) described some proposed methods for determining the sulfate resistance of portland cement. The lean mortar bars seem to give results in a fairly short time. A paper was presented by F. O. Anderegg on efflorescence which gives the fundamental physical chemistry involved in the appearance of and disintegration caused by soluble salts in combination with water in masonry. These phenomena were illustrated with 18 slides.

Gravel Plant

GLANDER WASHED SAND AND GRAVEL CO., Bridenthall Springs, Minn., has begun operations at its new sand and gravel plant which had been under construction since last fall. Cost of the plant was estimated at $100,000. Fred Glander, owner and operator, is also engaged in road surfacing and construction.

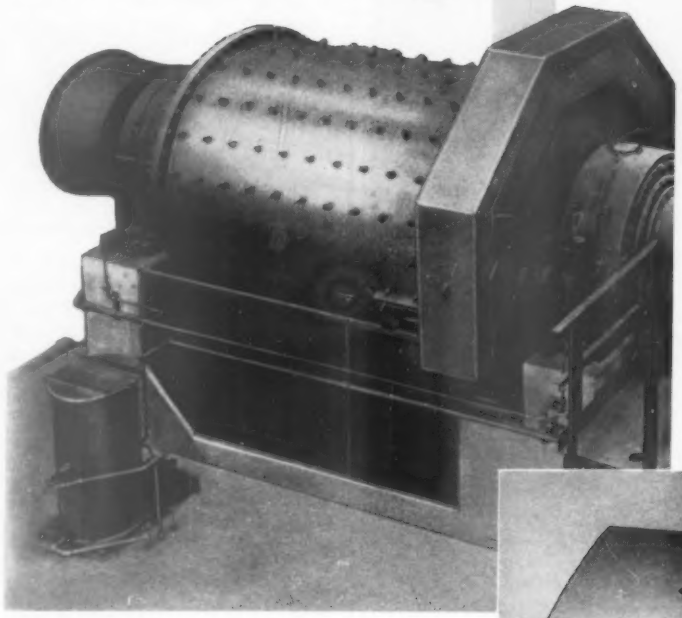
California Cement Outlook

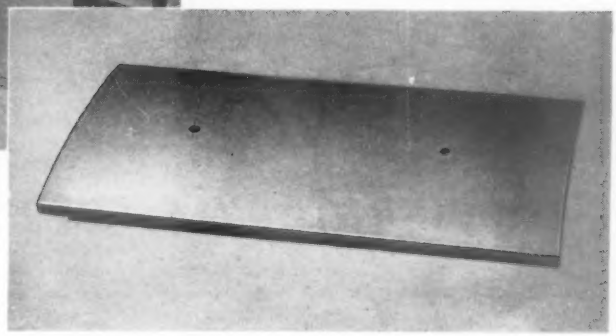
WILLIAM WALLACE MEIN, JR., president, Calaveras Cement Co., San Francisco, Calif., predicts that business in general and the demand for cement in particular should continue to grow in California during the next several years. He bases his predictions on the following factors:

1. California's population increase during the decade ended in 1950 was 53.3 percent, as against 14.5 percent for the nation, and the state's population is continuing to increase faster than the national rate.
2. The Pacific Gas & Electric Co. alone plans $450,000,000 in new construction in northern California during 1952 through 1954.
3. Millions of dollars are expected to be spent during the next ten years in modernizing highways.
4. Airport and other military construction can be expected to continue.
5. Reclamation projects, including dams and accessory canals and pumping plants will continue to utilize large amounts of cement for several years.

Mr. Mein stated that Calaveras Cement Co. has invested more than $2,500,000 in its current plant expansion program to help meet the growing cement demand.

rod mill liners of ABK METAL save money by providing extra life and continuous production





A large cement company in the Middle West had been using white iron liners in their rod mills—liners that lasted from three to five months in service.

Searching for a highly abrasion resistant material, they placed an order with American Brake Shoe Company, in 1947, for liners of ABK Metal and installed them in the same year. These and subsequently ordered ABK Metal liners are *still in service* at this particular plant. The reduction in replacement costs and the increased production effected substantial savings. Approximately 300 tons of liners are now in use in their mills.

If you are looking for an abrasion resistant metal, it will pay you to consider

ABK METAL *for better protection against abrasion*

AMERICAN Brake Shoe COMPANY

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"Prospective" Chemistry

(Continued from page 141)

tive the smaller the particle size. Of course, in the case of a piece of crushed quartz or other form of disintegrated silica a bond is broken between the silicon ion and an oxygen ion, but the fact that oxygen is practically everywhere available in an active state—in the atmosphere and in the hydrosphere (the waters of the earth)—makes it impossible for the exposed ion of silicon to remain unreacted upon by oxygen. The fact that the exposed oxygen ions on the surfaces of a particle of silica, regardless of its size, all have initially a vacancy in their outermost shells for another electron, is what gives silica some of its special properties, both as an ingredient in hydrated cement, and as an aggregate in concrete, or in asphaltic mixtures. Thus, the exposed O ions will grab on to a molecule of water by its hydrogen end, and the particle of silica is thus wetted.

The oxides of aluminum and iron are not so easily described. Aluminum (see Fig. 1B, July issue) has three valence electrons in its outermost shell and iron only two; but in the case of iron one of the electrons in the next-to-outermost shell may change over, so that iron may have a valence of three (ferric) or two (ferrous). The aluminum and iron atoms (or ions) are much larger than the silicon atom (or ion) and hence require larger spaces between the packed oxygen ions; they are in most cases 6- coordinated. As in the case of the silica tetrahedrons, the structure of Al_2O_3 is most easily conceived by assembling groups of three billiard balls with three more piled on top, in the closest kind of packing. The space in the center of the group would be larger than in the case of the four balls forming a tetrahedron, as in silica, and in this space would be an aluminum ion. This scheme, repeated as in Fig. 9, represents the lattice structure of one kind of Al_2O_3. It will be noted that while there are 12 oxygen ions to 6 aluminum ions in the group, there are 6 oxygen ions that

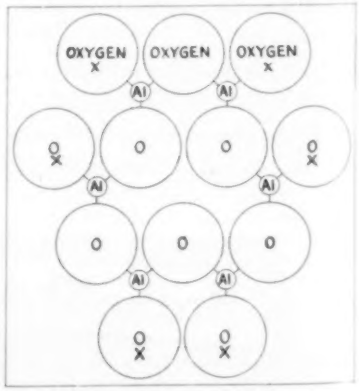


Fig. 9: Structure of Al_2O_3

do double duty by being bound to two aluminum ions (in the plane of the paper) and 6 oxygen ions which are bound to only one aluminum ion (but also bonded to those in a plane above or below), which gives the chemical formula Al_2O_3. The structure of Fe_2O_3 is similar.

While the structure of Al_2O_3 as a separate mineral is as described above, aluminum ions may substitute for silicon ions in a tetrahedron or 4-coordinated structure. But when this happens, the Al^{+3} ion leaves one O bond out, so the structure has gaps which may be filled by some other ion with a positive valence of one like Na^{+1} or K^{+1} (sodium or potassium). The various silicate minerals may also contain aluminum in 4-, 5- or 6- coordinations with oxygen.

(To be continued)

Industrial Minerals Meeting

THE INDUSTRIAL MINERALS DIVISION of the American Institute of Mining and Metallurgical Engineers will hold its fall regional meeting September 5, 1952, at the Palmer House, Chicago, Ill.

The morning session will be devoted to discussions of advances in industrial minerals. The following papers will be presented: "Trends in Great Lakes Bulk Transportation of Nonmetallic Materials," by Oliver T. Burnham, Lake Carriers Association, Cleveland, Ohio; "Coal Movement into the Chicago Area," by Walter Voskuil, Illinois Geological Survey, Urbana, Ill.; "The Development of the Cement Manufacturing Technology During the Past Century," by Jens C. Holm, Marquette Cement Manufacturing Co., Chicago, Ill.; and "Underground Mining of Silica Sands by Hydraulic Methods," by A. D. Bryant, Standard Silica Corp., Ottawa, Ill.

Papers presented at the afternoon session will pertain to advances in building materials and will include the following: "Engineering Research in Structural Clay Products," by Paul V. Johnson, Structural Clay Products Institute, Chicago, Ill.; "Development and Uses of Lightweight Aggregates," by Albert Litvin, Armour Research Foundation, Chicago, Ill.; "Developments in Aggregate Production in the Past Fifteen Years," by S. T. Harrison, J. L. Shiely Co., St. Paul, Minn.; "Lightweight Aggregates in the Chicago Area," by William Jackson, Silbrico Corp., Chicago, Ill.; and "Major Nonmetallic Mineral Building Material Industries in Metropolitan Chicago," by Kenneth A. Gutschick, Material Service Corp., La Grange, Ill.

County Gravel Plant

PRATT COUNTY, Kan., commissioners recently began operations at the new county-owned gravel plant at the northwest edge of the county lake. Sand and gravel are pumped through 6-in. pipe to the processing plant. Dragline and truck-loading facilities are to be added later.

Grinding at Trident

(Continued from page 156)

pump is supplied by a C-250 Fuller compressor.

An interesting feature of the design is a complete absence of conventional screw conveyors. All the horizontal conveyance is being accomplished with F-H Airslides with considerable saving in horsepower and maintenance and elimination of the safety hazard which always accompanies screw conveyors.

The mill building is a monolithic rigid frame concrete structure built by J. T. McDowell & Sons of Denver. It presents a very pleasing picture to the eye and illustrates very nicely one of the many uses that concrete can satisfy in the cement industry.

While the new finish grinding unit is primarily the first step toward an entirely new plant, it has served as a means of obtaining greater capacity from the existing plant. Clinker can be stored during the winter months while cement shipments are light and readily ground into finished cement during the summer months to meet the demand.

Ideal's general offices are in Denver, Colorado. C. K. Boettcher is chairman of the board, Cris Dobbins is president, M. O. Matthews, executive vice-president, and Thomas B. Douglas, general superintendent. Charles Burriss is the Trident plant manager. The engineering was done by Ideal's engineering staff supervised by George Wiley, general engineer.

Largest Dry Process Kiln

(Continued from page 138)

tions, a red light comes on when the O_2 reaches 3 percent, which is considered wasteful, or if the O_2 falls below 1 percent, which is thought to be too close to a reducing atmosphere. Also, a blue light shows at 2 percent combustibles and, after two minutes, the warning horn blows.

Under normal operation, if the O_2 reading exceeds the desired figure, the burner closes down the rear end damper. If the condition is not corrected, the alternative is to fire up with more fuel.

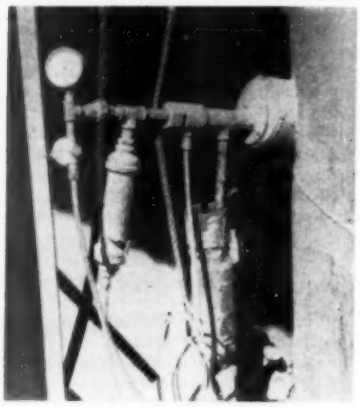
Practice in firing the kiln is to hold its speed constant at 65 r.p.h. The draft damper is regulated to hold an exit temperature of 1200 deg. F., O_2 in proper range and a slight suction at the hood, when possible. The kiln is producing a clinker of uniform high quality. Principal operating difficulty thusfar has been the formation of slag rings about 70 ft. from the hood, in the hot zone, but as experience is gained the frequency and size of the rings is being reduced.

Raw Grinding

Finish mill capacity was sufficient for the increased production of clinker due to addition of the long kiln, by operation of both the old clinker mill

and the new department which was installed in 1948. However, it was necessary to increase raw mill capacity by 50 percent and also to enlarge the output of crushed shale.

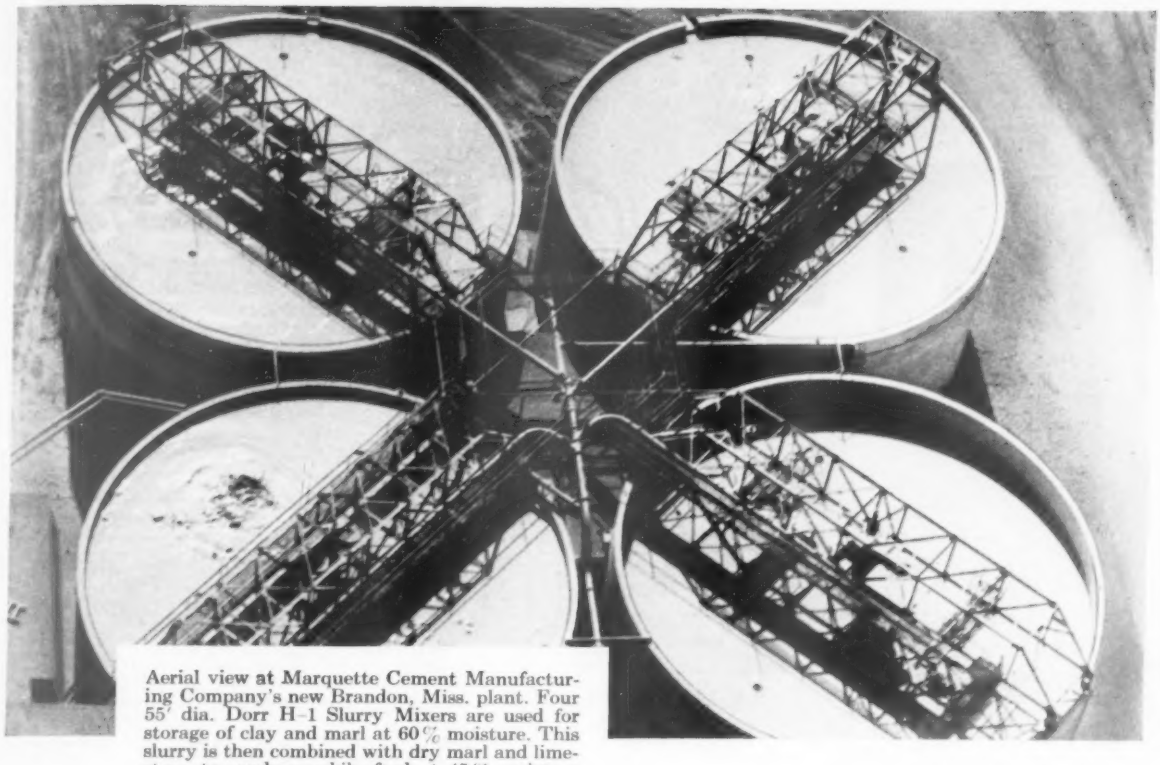
Raw material grinding capacity was increased from 6000 bbl. to 9000 bbl. per day by installation of new high capacity preliminary mills, which have replaced older types, and by changing the method of feed into the existing finish mills. The old set-up had two No. 66 Kominuters, a No. 85 Kominuter and a ring-roll mill for preliminary grinding in open circuit. Finish grinding was done through three No. 16 and one No. 18 Smidth tube mills, the three smaller mills being in closed-circuit with two 16-ft. mechanical air separators and the large mill in circuit with a separate air separator. In the new arrangement, finish grinding is unchanged except that a circulating system of feed has displaced the former method of feeding from overhead bins. The combination of a regulated rate of feed, without flooding and starvation, of a material ground to much greater fineness than before in the preliminary mills, has increased capacity to the required amount. Shale production was stepped up with installation of a Hammermills, Inc., Bulldog hammermill, replacing a dry pan. The new mill has an over-capacity in order to have the advantage of large feed opening. It is fed shale from an overhead bin by an apron-feeder operated by a push button control. Product of the crusher is elevated to the dryer feed bins.



Close-up of gas sampler tube

Crushed limestone and shale are dryed and handled as before. with two rotary shale dryers and one for limestone delivering to an oscillating conveyor from which bucket elevators fill overhead bins.

The new preliminary mill department comprises two Hercules mills, direct-driven by 350-hp. synchronous motors, which grind in open circuit. Source of feed is from a divided overhead limestone bin and a shale bin, each mill being fed accurately proportioned materials. The mills carry a 6-mesh discharge screen and the feed comprises 1½-in. minus lime-



Aerial view at Marquette Cement Manufacturing Company's new Brandon, Miss. plant. Four 55′ dia. Dorr H-1 Slurry Mixers are used for storage of clay and marl at 60% moisture. This slurry is then combined with dry marl and limestone to produce a kiln feed at 45% moisture which is stored in two similar units.

for your **BIG** *cement slurry storage job...*

You can't beat the Dorr Type H Slurry Mixer... today's best answer to the problem of large volume kiln feed storage for wet-process cement production.

First, it is powered by the Type H drive from which it takes its name . . . a rugged power-package incorporating balanced spur gears and extra-heavy duty construction.

Second, it utilizes a center shaft mechanism with the drive head supported by a truss spanning the tank. Requires no center pier and foundation . . . saves concrete and reinforcing steel . . . greatly simplifies the construction of deep tanks for cement slurry mixing. In short . . . saves dollars for you.

Add to these features the thoroughly proven mixing control effected through the rake and air lift principle of the Dorr Slurry Mixer. The result is the best possible slurry storage unit in the 45′ to 70′ dia. range . . . at a reasonable installed cost. For more detailed information write to The Dorr Company, Stamford, Conn., or in Canada, The Dorr Company, 80 Richmond Street, West, Toronto 1.

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stone and ½- to 1-in. shale proportioned in the approximate ratio of 5:1.

Method of feed into the mills is of particular interest. Each mill has a separate pair of Jeffrey Waytrol (constant-weight control feeders), one for limestone and one for shale, which discharge into a common spout directly into each mill. Each pair of Waytrols is equipped with Dynamatic Adjusto-Spede drives (see ROCK PRODUCTS, January, 1952, issue, page 142, for description of the Adjusto-Spede principle) which will automatically control the speeds of the Waytrol belts to maintain the set proportions of limestone and shale even as these speeds are changed. Changing the speed of these feeder-weighers changes the total weight of feed to the mills. Total weight is held automatically to conform with a preset amperage on the mill motor which is operated with Westinghouse Slipsyn synchronous motor control. Should the amperage exceed the limiting figure, the total feed material will be cut automatically while continuing to maintain the established limestone-shale weight ratio. A counter on each Waytrol shaft provides a record of production. If weighing should become inaccurate, a warning signal will sound.

Purpose of this hook-up of feeders, aside from accurate proportioning, is to keep the grinding mills uniformly loaded at a top production rate, as established by the amperage holding point. Ordinarily, mills of this type are fed from table feeders, or possibly belt feeders, which kick off under overloads and then start up again. In this installation, both overloading and underloading are eliminated which is expected to result in lower maintenance costs. Segregation of feed materials is also less. The overhead hoppers have been insulated and heated air from the dryer hoods is to be piped into the tops of the bins to prevent condensation as an aid to flow of materials during cold weather months.

Each mill is producing 66 t.p.h. of a product 100 percent minus 6-mesh, about 52 percent through the 100-mesh and 43 percent minus 200-mesh. The mill product is elevated and carried over to the raw mill finishing department by two parallel 16-in. screw conveyors. These conveyors ordinarily transfer into two parallel 16-in. screw conveyors spanning the building at right angles to the centerlines of the tube mills, which are in a single row.

These conveyors carry a stream in excess of the mill requirements and the quantity in excess of that drawn through spouts into the separate mills is returned by screw conveyors into a reserve bin. Incoming feed material from the preliminary mills can also be diverted into this bin, from which material may be drawn for elevation and circulation over the mills. Half-pitch screw feeders with variable

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(Above) Model TD Rear-Dump Euclid. 22 ton capacity . . . 14.8 cu. yds. struck . . . loaded top speed 32.4 m.p.h. . . . powered by 286 or 300 h.p. diesel engine.

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REAR-DUMP EUCLIDS are engineered and built for lasting strength. Their ability to stay on the job, day after day and year after year, means more tons moved at lower cost . . . "plus" performance for owners.

"Euc" bodies have extra thick plates reinforced with heavy box section side and bottom supports. The rugged frames are built to withstand the impacts of hauling and dumping big loads . . . they're built to take the pounding and wear of loading earth, rock and other heavy excavation by large shovels and draglines.

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For information on equipment that is job proved on work similar to yours, get in touch with your Euclid Distributor or write direct for literature on the complete line of Euclid models.

The EUCLID ROAD MACHINERY Co., CLEVELAND 17, OHIO

EUCLIDS *Move the Earth*

speed drives regulate the rate of draw-off from the overhead circulating stream into the separate mills.

Substitution of this circulating system of feed for the old hoppers has eliminated the difficulty of flushing and starvation of feed which had always been a handicap to production.

Raw material is ground to a fineness of 85-88 percent minus 200-mesh and is conveyed from the air separators by a 16-in. F-H Airslide into the hopper of a 10-in. F-K pump for transfer into the blending bins. Blending bin capacity is 24,000 bbl. in four separate tanks. Material is drawn simultaneously from the separate tanks for transfer into the kiln feed bins by 10-in. F-K pump.

General

Louisville Cement Co.'s engineering department, headed by chief engineer Thomas McDonald, did the engineering work for the entire program.

Under the existing corporate structure, Eugene D. Hill is president of the Louisville Cement Co. with headquarters in Louisville, Ky. Ray K. Hartsock, vice-president in charge of production, and chief engineer McDonald have their headquarters at Speed, Ind. The plant at Speed is operated by the Louisville Cement Corp. of which D. E. Willingham is president; William Leake is vice-president and superintendent of operations, and Wallace H. Leach, chief chemist.

Standard portland cement, air-entraining and high early strength portland cements are manufactured at Speed. Brixment mortar cement is produced in an adjacent plant and also at Akron, N.Y. Lime is produced at Milltown, Ind., and commercial crushed stone at both Speed and Milltown.

Safety Booklets

THE NATIONAL SAFETY COUNCIL has announced the publication of four safety booklets as additions to its series of job-training booklets. "Steps to Safety" presents a check list of sound safety rules stressing such topics as materials handling, protective clothing, machinery guards, fire prevention and housekeeping. "It Pays to Dress Well" gives detailed information on protective clothing and equipment. "Ship Shape" extolls the advantages of good housekeeping, and "Down Time" warns the worker that he must show his body the same consideration as he does his machine if he is to avoid the high cost of human "down time."

These four 16-page, pocket-size booklets are printed in color and illustrated with cartoons. They can be purchased by National Safety Council members for $0.03 per copy in large quantities. Prices to nonmembers are double. Sample copies will be sent free on request to the National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

Wage and Salary Stabilization Developments

THE NATIONAL CRUSHED STONE ASSOCIATION, to assist its membership in keeping abreast of the ever-changing government regulations, recently issued a memorandum, prepared by its counsel, Gall, Lane and Howe, listing a number of recent developments in the regulations governing wage and salary controls. The following changes were noted:

Wage Stabilization

1. By a recent amendment of Section 4 of General Wage Regulation 8, the Wage Stabilization Board permits employers to grant certain limited "cost-of-living" increases to their employes, even though they have previously given their employes, with W.S.B. approval, increases in excess of the 10 percent "catch-up" increase permitted by General Wage Regulation 6. Prior to this amendment, no cost-of-living increase could be given where the 10 percent increase authorized by Regulation 6 had been exceeded.

2. Paid sick leave benefits are to be treated as health and welfare benefits under General Wage Regulation 19, and not as fringe benefits under General Wage Regulation 13. Petitions for approval of paid sick leave will go to the Wage Board's Health and Welfare Committee for consideration in the future.

3. The Wage Board has modified its industry and area practice for approvable fringe benefits. Under the new policy proposed, fringe benefits may be approved even though they do not conform to area and industry practice if they are not unstabilizing, and if the industry or area practice test is inappropriate.

4. The W.S.B., under Interpretation Bulletin 17, has issued a series of rulings on problems arising under the various regulations. Some of the more important interpretations were listed as follows:

(a) In calculating the amount available for a "catch-up" increase under Regulation 6, decreases in the pay of some employes do not raise the amount available to be given as a general increase to other members of the employe unit.

(b) The bulletin contains an extensive discussion, with numerous examples, of how to apply the "catch-up" and "cost-of-living" increases in regards to employes paid on piece and incentive rates.

(c) Construction employes who do shop or inside work as well as work at the site of construction projects are governed by W.S.B. regulations insofar as their shop work is concerned. Such employes come under the Construction Commission's jurisdiction only when they are actually doing construction work.

5. By resolution, issued May 27, 1952, W.S.B. permits employers to give the Saturdays after Memorial

Day and Independence Day as additional paid holidays to employes who normally work on Saturdays. The amount paid to such employes need not be set off against the amount available for "catch-up" increases.

Salary Stabilization

1. The Salary Stabilization Board has issued a complete revision of General Salary Stabilization Regulation 4, covering stock option and stock purchase plans. The revised regulation somewhat relaxes the requirements for plans that can be put into effect without prior board approval. However, stock option and stock purchase plans still may not be used to give salary increases not otherwise available under S.S.B. regulations.

2. S.S.B. has also issued a new order governing bonus plans. Previous to the issuance of the new order, bonuses for salaried employes were governed solely by General Salary Stabilization Regulation 2 which prevented the payment of bonuses by employers who did not pay bonuses during the 1946-1950 period. The new order, General Salary Order 12, permits employers not covered by Regulation 2, to pay bonuses with a fund obtained from unused amounts available for increases under Section 8 of Regulation 1 (the 10 percent "catch-up" formula) and General Salary Order 6 (cost-of-living, productivity, etc.)

3. S.S.B. has issued a revised form for application for approval of salary increases. The new form is Office of Salary Stabilization Form 300-12, Revision No. 1, May, 1952.

4. A new general regulation governing health and welfare plans has been adopted by the salary board. The new regulation (G.S.S. Reg. 8) supersedes Order 11 which previously fixed board policy on such plans. It is similar to the old regulation except it permits plans to be put into effect without prior board approval, where the employes covered pay at least 40 percent of the premiums, or, if the plan includes dependents of covered employes, 50 percent of the premiums.

5. General Salary Order 13, issued May 2, 1952, permits employers to contract for, and to pay, death benefits up to $5000 without prior board approval.

6. The board has released Interpretation Bulletins 6, 7 and 8 which are in question and answer form. Number 6 deals with extended work-week compensation under General Salary Order 10, in which salaried employes can be paid the equivalent of overtime compensation; No. 7 covers stock option and purchase plans under Revised General Salary Stabilization Regulation 4; No. 8 is concerned with the effect on salaries produced by a change in the legal structure of the business, such as a change from a partnership to a corporation.

7. Section 5 of General Salary

you can go down and get it 15" below grade

you can go up and get it 15 feet above grade

—and do it with CROWD AND HOIST . . . no wheel traction . . .

If you are doing excavation work you probably realize the mechanical advantages of big shovels—simultaneous and independent hydraulic crowding and hoisting, variable crowd action at any dipper position, changeable buckets, etc. But, do you know all these advantages have been engineered into the Dempster-Diggster to give you a faster, more versatile excavator, on pneumatic tires with a 1 cu. yd. capacity. In addition the Dempster-Diggster does anything a conventional front end loader can do—and does it faster at less cost with its 1½ or 2 cu. yd. bucket. In excavation the Dempster-Diggster is without equal for working in tight places . . . dumps at 11'3" height . . . travels at truck speeds from job to job. The versatile Dempster-Diggster is a fast, power-packed excavator and loader you can't afford to be without! Write today for our new catalog No. 1032. A product of Dempster Brothers, Inc.

DEMPSTER DIGGSTER
TRADE MARK REG.

DEMPSTER BROTHERS, 382 N. KNOX, KNOXVILLE 17, TENNESSEE

Stabilization Regulation 3, governing adjustments in the compensation of individual employes, has also been amended. The amendment permits an employer to pay to a demoted employe the salary for his former position if the employe had held the former position for at least three years. Prior to the amendment, a demoted employe could be paid no more than the salary for the position to which he was demoted.

Gypsum Production

PRODUCTION OF CRUDE GYPSUM and most gypsum products during the first quarter of 1952 was substantially less than in the first quarter of 1951, as reported by the Bureau of Mines. Domestic crude mined was 14 percent less, while imports of crude gypsum showed a 35 percent decrease. Portland cement retarder and agricultural gypsum decreased 17 and 25 percent, respectively, and there was a decline in most gypsum plasters. Gypsum board products showed the following decreases: lath, 28 percent; wallboard and laminated board, 10 percent; and sheathing, 23 percent.

Production of gypsum and gypsum products was reported as follows:

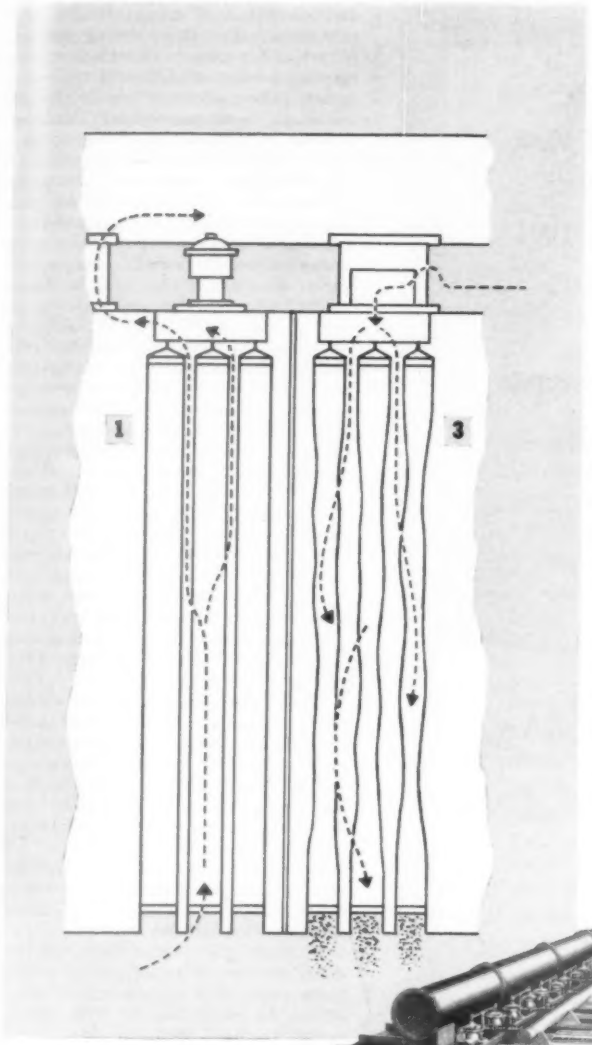
	Short tons	
	First quarter	
	1952	1951
Crude gypsum:		
Mined	1,797,382	2,102,006
Imported	400,679	613,493
Calcined gypsum produced	1,582,175	1,837,535
Gypsum products sold or used:		
Uncalcined uses:		
Portland cement retarder	334,839	405,087
Agricultural gypsum	185,280	248,468
Fillers and unclassified	5,919	6,915
Industrial uses:		
Plate glass and terra cotta plasters	11,121	18,081
Pottery plasters	11,471	13,361
Dental and orthopedic plasters	2,432	3,807
Other industrial uses	42,397	41,727
Building uses:		
Plasters:		
Base-coat	451,841	512,238
Sanded	39,469	30,617
To mixing plants	3,316	4,265
Gauging and molding	44,057	49,736
Prepared finishes	4,126	4,139
Other building plasters	43,122	49,127
Keene's cement	13,086	14,328
Lath*	508,785	710,197
Wallboard and laminated board*	738,236	819,826
Sheathing*	23,330	30,107
Tile and miscellaneous*	7,602	10,002

* M sq. ft.

Ceiling Price Adjustments

OFFICE OF PRICE STABILIZATION recently issued Supplementary Regulation 106 to the General Ceiling Price Regulation. The new regulation, which became effective June 24, 1952, permits producers, manufacturers and resellers of specified building and construction materials to adjust their ceiling prices to reflect certain increased transportation costs resulting from freight rate increases authorized after January 26, 1951.

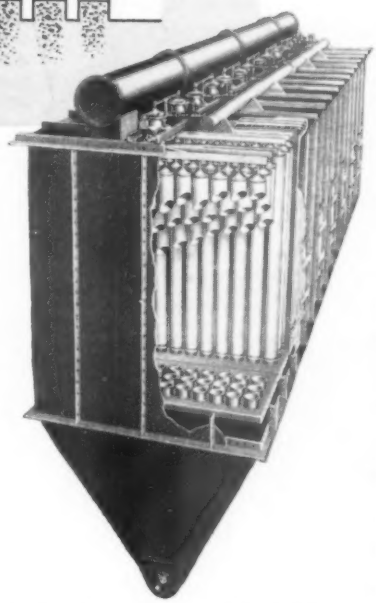
Manufacturers of certain building



How Norblo gives you 24-hour-a-day dust collection at full rated capacity

Fast double-action bag cleaning assures full efficiency and constant suction drop across the arrester

No matter what the task in large scale continuous operation, Norblo equipment stands the gaff — with low maintenance and economical over-all cost. Norblo Automatic Bag Type Dust Collectors have been completely reliable in all types of installations for over 25 years, proving the soundness of the operating principles described below:



1 Basic unit compartment houses 78 cylindrical bags — fully distended by upward inside air flow.

2 Variable timing of cleaning cycle, easily adjusted according to dust load, insures constant volume of air handled and constant static pressure drop across the arrester.

3 Bag cleaning involves only one compartment at a time, and only a few seconds out of each hour of operation. During cleaning period bags are shaken and air flow is reversed, loosening dust and accelerating its descent into the hopper. *This double-action bag cleaning insures utmost efficiency of the equipment and in no way interrupts the suction drop.*

4 Any compartment may be cut out of operation for bag replacement or repair, all other compartments remaining in operation.

Norblo Equipment is completely designed and fabricated in our own shops and sold on the basis of *guaranteed performance.* Let us send you Bulletin 164-3.

THE NORTHERN BLOWER COMPANY

Engineered Dust Collection Systems for All Industries

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and construction materials are permitted to adjust their ceiling delivered prices for these materials to reflect increased costs of outbound transportation. The following materials are included: asbestos-cement building products, limited to shingles, flat sheets and corrugated sheets not further fabricated; asbestos-cement pipe; blast furnace slag (except when used as an agricultural liming material); calcined gypsum plasters and Keene's cement; cement; concrete products; clay drain tile; crushed stone (except when used as an agricultural liming material); fiber insulating board; gravel; gypsum products (excluding acoustical tile); lightweight aggregates; lime (construction, metallurgical, chemical and refractory) except when used as an agricultural liming material; sand; structural clay products and allied clay products; and vitrified clay sewer pipe and allied clay products. A producer or manufacturer of any of these products, for which he has a ceiling delivered price, may adjust his ceiling delivered price for any such material, by the exact amount of authorized increases in cost of transportation by carrier that have been made or may be made after January 26, 1951.

Manufacturers of ready-mixed concrete, concrete products and asphaltic concrete and bituminous paving mixes may add to their ceiling prices the increased costs to them of inbound transportation of the materials listed in the regulation which enter into the manufacture of these products.

Resellers of the listed materials are also permitted to adjust their ceiling prices to reflect increased costs of inbound transportation.

In order for a manufacturer, producer or reseller to adjust his ceiling price under this supplementary regulation, he must comply with certain record-keeping requirements. First, he must have received a carrier's invoice, freight bill, or other statement of transportation, or invoices from suppliers who sell to him on a delivered basis, to show that his costs have been increased because of increased transportation costs. Such invoices or freight bills must be kept for two years. In addition, those adjusting their prices because of increased inbound transportation costs must prepare a worksheet showing in detail the calculation of that adjustment, and each such worksheet must be kept for a period of two years after making such adjustment, together with the carrier's invoice, freight bill or supplier's invoice.

Federal Highway Aid

THE FEDERAL AID HIGHWAY BILL, amounting to $1,385,000,000 for the fiscal years of 1954 and 1955, was recently signed by President Truman. Congress had passed the measure on June 11, in face of administration demands for a cutback. Regular authorizations for state participation total

$575,000,000 annually including, for the first time, $25,000,000 for the interstate highway system.

Other major authorizations include $50,000,000 for defense access roads and a $10,000,000 emergency fund. In addition, miscellaneous authorizations for forest development and other public land roads total $77,500,000 annually. Provision is also made for the Inter-American Highway and the Rama Road in Nicaragua in the respective annual amounts of $8,000,000 and $2,000,000.

Idaho Test Road

THE WASHO TEST ROAD being built about half way between Pocatello, Idaho, and Ogden, Utah, just north of the Utah-Idaho border, is expected to be completed by September. The test road is part of a research project planned to help solve the pavement-design problem in relation to truck weight. The project was inaugurated by the Western Association of State Highway Officials and is known as the Washo Road Test.

Ten western states (California, Colorado, Idaho, New Mexico, Nevada, Oregon, Texas, Utah, Washington and Wyoming), the Bureau of Public Roads, vehicle manufacturers, the petroleum industry and other agencies are cooperating in this extensive test. The administration, road construction, test supervision and analyses of the results have been assigned to the Highway Research Board, a cooperative organization of the highway technologists of America, operating under the auspices of the National Research Council and with the support of the American Association of State Highway Officials, the Bureau of Public Roads and other organizations interested in the development of highway transportation.

Plans and specifications for construction of the road were prepared by the Idaho Department of Highways, in accordance with directives of the W.A.S.H.O. Standard Committee. The construction contract was awarded to Carl E. Nelson Co., Logan, Utah, for approximately $200,000.

Two loops of identical design are being built, each with 1900-ft. tangents, 100 ft. apart and connected at the ends with 150-ft. radius "turnarounds." Each tangent of each loop will contain five different pavement thicknesses (6, 10, 14, 18 and 22 in.), established in order to evaluate past, present and possible future design practice.

When the test sections are completed, pretest traffic made up of empty trucks will be operated for about two weeks in a uniform pattern over each test section to condition the surface. Following the pretest period, eight tractor-semitrailer combinations, loaded with concrete block, will be used. The trucks will operate in pairs, four vehicles on each test loop, two in the outside lane and two in the inside lane. On one loop, single-

axle combinations will be used, with 18,000-lb. axle loads running on the inside lane and 22,400-lb. axle loads on the outside lanes. On the other loop, tandem-axle combinations will be used with 32,000-lb. tandem-axle loads on the inside lane, and 40,000-lb. axle loads on the outside. At the planned rate of operation, each section will undergo about 720 truck-trailer applications per day, or 18,750 per month. It is planned to continue the test traffic for a total of six months, part this fall and the balance next spring. When the tests are completed, the test section will be incorporated in the Idaho highway system.

Order M-78 Amended

NATIONAL PRODUCTION AUTHORITY has amended Order M-78 which covers procedures for obtaining MRO items, minor capital additions and major capital additions. The amended order, which became effective June 13, somewhat relaxes controls and provides assistance to certain producers in the mining industry.

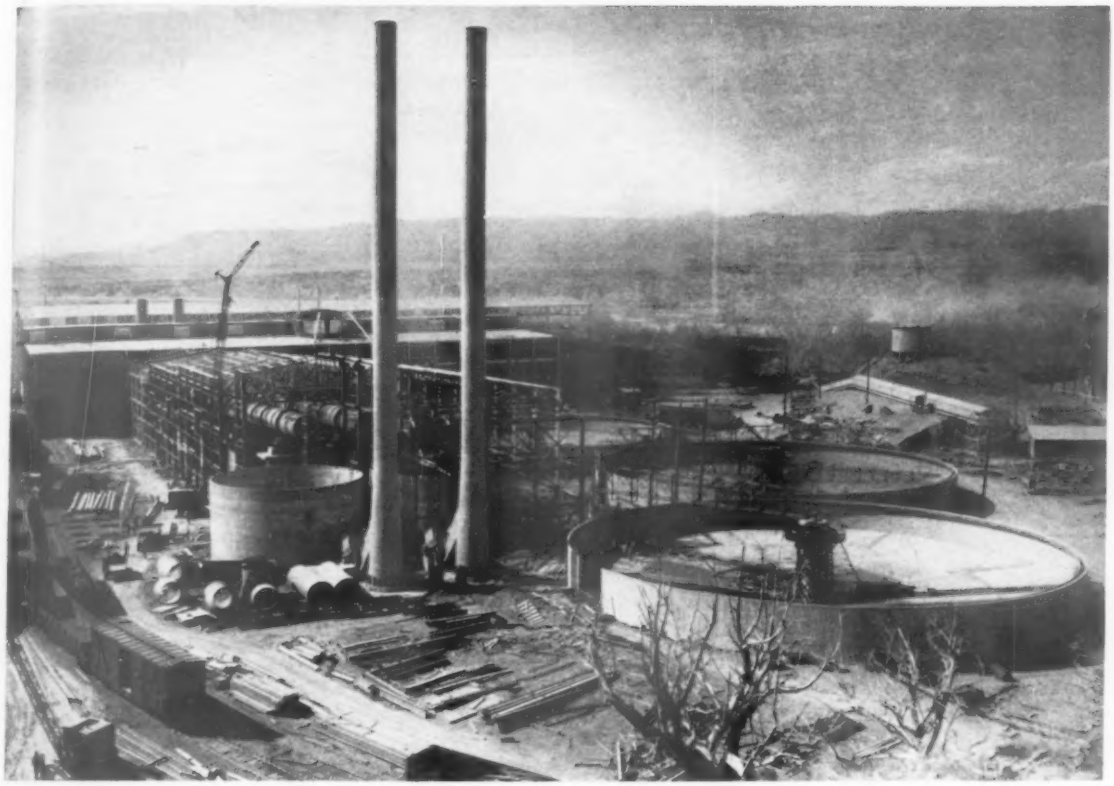
The major change of the amended order increases from $2000 to $5000 the limitation on minor capital additions obtainable under the self-authorization procedures. It also permits the purchase of drilling equipment, drifters, screens, conveyors, and such, without a priority rating, providing the expenditures are limited to $5000. If materials for minor capital additions are obtained without the use of the allotment number or rating, the regulation imposes no limitation. However, MRO expenditures must be charged against the quota whether or not obtained by the allotment number and rating. There is no change in the allotment number or rating. The quarterly quota continues to be one-fourth of 120 percent of the quota base.

If a producer does not use his allotment number and rating for more than 20 percent of his MRO quota in any quarter, he is not bound by quota limitations. Also, if his quarterly MRO quota is less than $10,000, he may order (or receive) in any quarter MRO aggregating more than $10,000 through the use of his allotment number and rating. If a producer wants his quota adjusted, he must file an application on Form DMPA-28.

Other changes in the amended order include: (1) revisions designed to make M-78 conform with the provisions of CMP Regulation 5; (2) simplified procedure for foreign producers to procure equipment and controlled materials; and (3) emergency assistance provisions for operators suffering major breakdowns due to fire, floods or similar mishap.

Sand and Gravel Plant

FRED GLANDER, Gaylord, Minn., has begun operations at his new sand and gravel plant at Le Sueur, Minn.



View of the Ideal Portland Company's Cement Plant at Portland, Colorado, under construction. This plant was designed and constructed by Stearns-Roger in accordance with customer's specifications. It was completed and placed in operation September 24, 1948.

A duplicate of the Portland plant was built concurrently at Devil's Slide, Utah. Both plants represent the latest in design and construction, and are considered to be the most modern Cement Plants in existence. Each has a daily capacity of 4,000 barrels of finished cement.

UNDIVIDED RESPONSIBILITY

- ENGINEERING
- DESIGNING
- MANUFACTURING
- CONSTRUCTION

- *Stearns-Roger engineers will be glad to discuss your problems of engineering and construction with you, and to outline a program to meet your requirements.*

Stearns-Roger

THE STEARNS-ROGER MFG. CO. DENVER, COLORADO

Agricultural Limestone

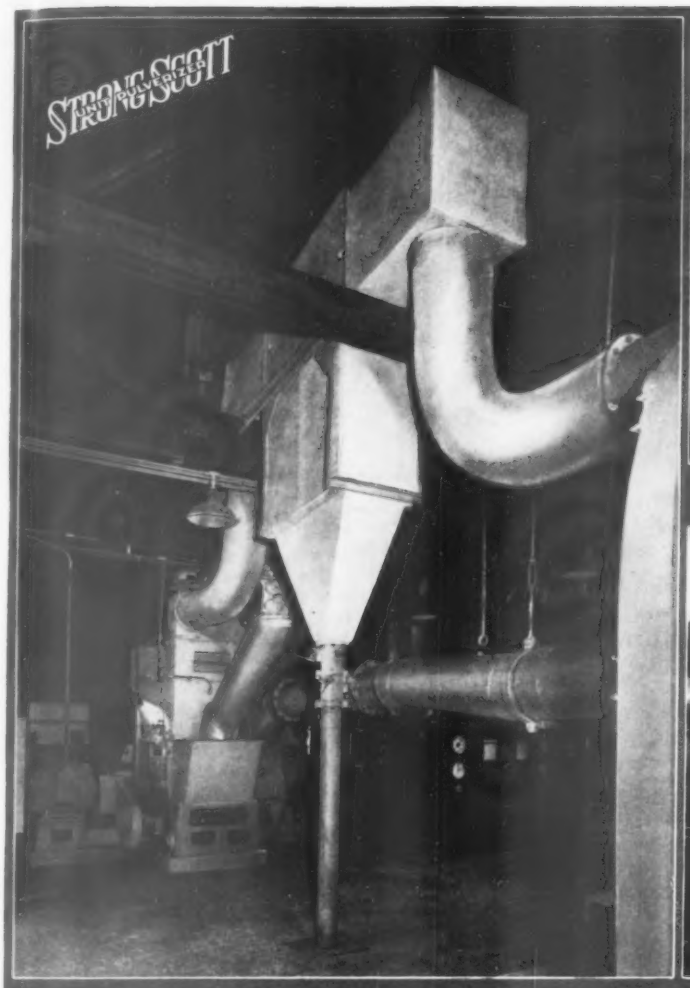
THE NATIONAL AGRICULTURAL LIMESTONE INSTITUTE reports that the agricultural limestone tonnage used in the United States in 1951 was somewhat lower than the total tonnage consumed in 1950. The decrease was attributed to four principal reasons: (1) some states were allocated less funds for their 1951 A.C.P. program; (2) fertilizer, particularly superphosphate and phosphate, received a higher percentage of A.C.P. funds in 1951 than in 1950; (3) floods and other adverse weather conditions materially reduced the tonnage in some states; and (4) criticism developed in large part by the Soil Conservation Service both within the Department of Agricultural and through influential Congressmen that more emphasis should be given to so-called permanent type practices and less to annual or recurring practices has resulted in some counties channeling more of their funds away from limestone.

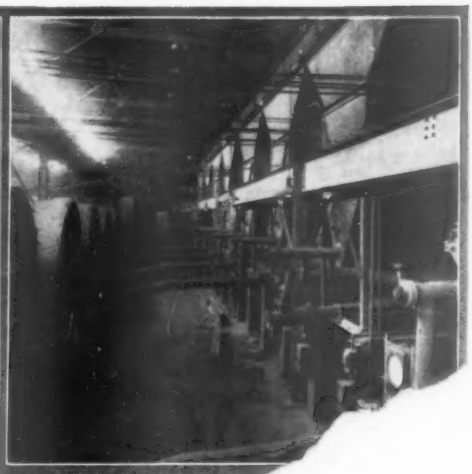
The tonnage of agricultural limestone used in the United States in 1951 compared with the 1950 tonnage, was listed by the National Agricultural Limestone Institute as follows:

State	1951	1950
Alabama	170,532	191,763
Arkansas	279,755	117,854
California	19,367	22,870
Colorado	502	None
Connecticut	67,789	73,240
Delaware	56,263	57,992
Florida	261,488	225,968
Georgia	375,164	311,261
Idaho	None	9
Illinois	4,156,281	4,985,397
Indiana	2,614,622	2,856,342
Iowa	3,192,384	3,502,516
Kansas	671,952	727,415
Kentucky	1,069,661	1,197,276
Louisiana	98,382	103,641
Maine	61,485	72,124
Maryland	309,635	345,297
Massachusetts	58,384	66,283
Michigan	601,280	720,342
Minnesota	411,043	467,788
Mississippi	352,169	297,346
Missouri	3,027,807	3,701,463
Montana	100	140
Nebraska	52,706	31,274
New Hampshire	37,267	38,963
New Jersey	180,220	182,474
New Mexico	None	15
New York	795,281	722,678
North Carolina	485,975	428,522
North Dakota	500	None
Ohio	2,311,142	2,204,173
Oklahoma	345,189	395,275
Oregon	82,511	86,346
Pennsylvania	1,304,645	1,319,314
Rhode Island	13,069	11,309
South Carolina	122,995	155,263
South Dakota	15	None
Tennessee	602,482	688,340
Texas	112,506	72,158
Utah	None	12
Vermont	86,184	105,427
Virginia	855,686	960,480
Washington	24,005	25,296
West Virginia	295,325	277,483
Wisconsin	1,790,248	2,075,626
Wyoming	4,126	17,390
Totals	27,358,120	29,842,145

Maintenance Booklet

GULF OIL CORP. has announced the publication of the revised 4th edition of "Lubrication & Maintenance Guide for Contractors' and Allied Equipment." It is a 96-page, pocket-size booklet containing information on the lubrication and maintenance of equipment for quarries, crushed stone, sand and gravel, ready-mixed concrete and





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BURN ANY FUEL AVAILABLE . . . . low-grade bituminous or high-grade eastern coal, or gas, or oil . . . . and take every advantage of your local fuel market. In these uncertain times, you MUST keep your fuel costs as low as possible.

With STRONG-SCOTT Unit Pulverizers you can do just that. Fire your kilns, driers, or waste-heat boilers with efficient, flexible, low-cost equipment . . . . easy to operate, control, and maintain, STRONG-SCOTT pulverizers are "the burner's delight."

*ASK THE MAN WHO OWNS ONE . . . or more**

*users' names on request.

THE STRONG-SCOTT MFG. CO.

MINNEAPOLIS 13, MINNESOTA

asphalt plants, in addition to contractors' equipment.

The new guide book deals with some 45 lubrication and maintenance items such as engine types, engine lubrication, air compressors, air tools, open gears, wire rope, shovels and draglines, conveyors and elevators, crushers, air cleaners, oil filters, care of carburetors and ignition systems, antifreeze requirements, correct valve maintenance, diesel fuel injection equipment, chassis lubrication, steering gears, power brakes and hydraulic systems. Also included is information on the storing of equipment and the removal of equipment from storage, care of tires, dust control, storage battery maintenance and the storage and handling of petroleum products.

Another section deals with A.P.I. classification of motor oils and the recommended oil for use under prescribed conditions, S.A.E. viscosity numbers for crankcase oils, and the S.A.E. transmission and axle lubricant classifications.

The booklet may be obtained without obligation from Gulf Oil Corp., Gulf Refining Co., 719 Gulf Building, Pittsburgh 30, Penn.

Lime Company Securities

DAYTON HAIGNEY & Co., a securities firm at Boston, Mass., has listed the prospectus of New England Lime Co., Adams, Mass., and Canaan, Conn., as follows: $425,700 debentures 3-6 percent, due January 1, 1966; 476 shares of preferred stock (unexchanged); 69,622 common shares, no par value; and lists the company as one of the largest producers of high calcium and building lime. Earnings per common share were listed as $1.58 in 1949; $2.51 in 1950; and $3.04 in 1951. Approximate price of the stock, as of May 2, 1952, was listed as $12 per share, net.

Material Handling

THE MATERIAL HANDLING INSTITUTE and the American Material Handling Society, in cooperation with leaders in the field of engineering education, have formed an autonomous College-Industry Committee on Material Handling Education. The objectives of the committee were listed as follows:

1. To make available to colleges and other study groups material of recognized quality for use in courses on material handling.
2. To initiate development of new material, not presently available, for use in such courses.
3. To become known as a source and authority on sound good-quality information for material handling courses.
4. To stimulate more teaching of material handling (and the importance of material handling) in the nation's colleges and universities.
5. To determine from industry what skills and understanding it requires in the material handling engineers the colleges turn out.

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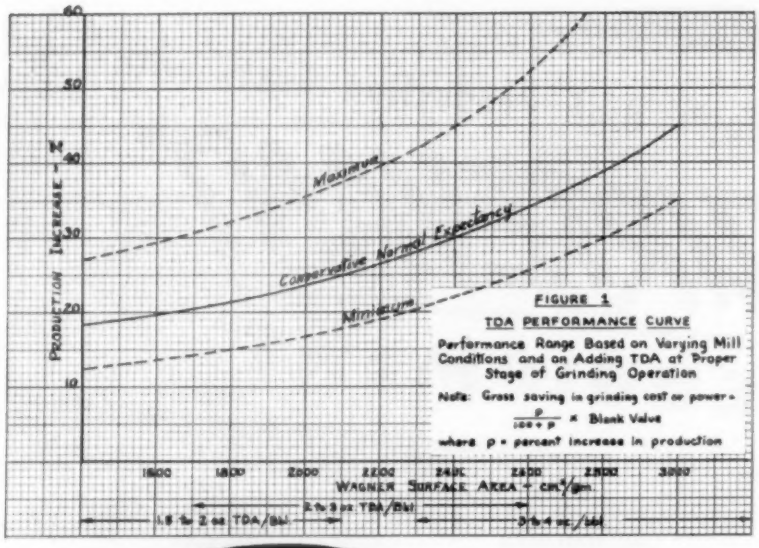


FIGURE 1
TDA PERFORMANCE CURVE
Performance Range Based on Varying Mill Conditions and on Adding TDA at Proper Stage of Grinding Operation

Note: Gross saving in grinding cost or power = $\frac{p}{100+p}$ × Blank Value
where p = percent increase in production

FINANCIAL

RECENT DIVIDENDS

Basic Refractories, Inc.—Q	$ .25	June 30
Basic Refractories, Inc.—pf	1.43¾	July 1
California Portland Cement Co.	.40	July 25
Canadian Crushed & Cut Stone—pf	1.50	July 2
Canada Cement Co., Ltd.—pf	.32½	June 20
Coronet Phosphate Co.—Q	2.00	June 30
Gypsum Lime & Alabastine, Can., Ltd.	.50	Sept. 2
Gypsum Lime & Alabastine, Can., Ltd.	.50	Dec. 1
Medusa Portland Cement Co.	.60	July 1
Missouri Portland Cement Co.	.75	June 27
National Gypsum Co.—Q	.35	July 1
Pacific Coast Aggregates, Inc.	.10	June 25
Pennsylvania Glass Sand Corp.—Q	.30	Oct. 1
Pennsylvania Glass Sand Corp.—Q—pf	1.25	Oct. 1
Permanente Cement Co.—Q	.30	June 30
Warner Co.—Q	.40	July 15
Whitehall Cement Mfg. Co.—Q	1.00	Sept. 30

CELOTEX CORP., Chicago, Ill., lists a net income of $119,767 for the six months ended April 30, 1952. This compares with a net income of $1,594,277 for the same period of the preceding year. Net sales for the period ending in 1952 totaled $20,926,223, as against $27,898,606 for the same period of the previous year.

KENTUCKY STONE CO., Louisville, Ky., reports a net income of $231,369, or $7.43 per common share, on 28,800 shares, and $33.47 per preferred share, on 6912 shares, for the year ended April 30, 1952. This compares with a net income of $175,786 or $5.52 per common share and $26.25 per preferred share (on 6696 shares) for the year ended April 30, 1951. Net sales for the year ending in 1952 totaled $1,890,924, as against $1,538,887 for the preceding year.

LEHIGH PORTLAND CEMENT CO., Allentown, Penn., has listed the following account of income for the three months ended March 31:

	1952	1951
Sales	$ 8,144,497	$ 8,068,774
Net before taxes	1,683,649	2,340,682
Fed. income tax	1,080,000	1,400,000
Net profit	603,649	940,682
Earn., common share	$0.32	$0.99
No. of common shares	1,901,560	950,780

BOSTON SAND & GRAVEL CO., Cambridge, Mass., has reported a net profit of $63,589 for the year ended December 31, 1951, as against a net profit of $111,878 for the preceding year. Earnings per common share, on 48,935 shares, amounted to $0.28 in 1951, compared to $1.27 in 1950. Earnings per preferred share, on 14,221 shares, amounted to $4.47 in 1951 and $7.87 in 1950. Sales for 1951 totaled $3,660,471, compared with $3,597,542 for the previous year.

BLUE DIAMOND CORP., Los Angeles, Calif., has reported gross sales of $2,774,771 for the three months ended March 31, 1952. This compares with $3,809,952 for the same period of the preceding year.

CALAVERAS CEMENT CO., San Francisco, Calif., reports net sales of $1,121,703 for the first quarter of 1952, which compares with net sales of $1,342,069 for the same quarter in 1951.

MANUFACTURERS NEWS

Sheffield Steel Corp., Kansas City, Mo., has announced the appointment of A. L. Bard as manager of grinding media sales, with offices in Kansas City, Mo. He was formerly in charge of engineering sales and development of grinding media and succeeds George P. Lacy, who was appointed manager of sales, wire division.

Thermoid Co., Trenton, N.J., announces that Lester F. Cox has been elected executive vice-president and executive manager. Mr. Cox has been associated with the company for 22 years. He is a graduate of Rider College, Trenton, and advanced studies at Rutgers University. Widely known in the rubber manufacturing industry, Mr. Cox in 1951 was named senior vice-president in charge of manufacturing and engineering for the company's seven plants. Now as executive manager he will supervise all divisions of the Thermoid Co., which manufactures rubber, friction and textile products for the automotive and industrial markets.

Lester F. Cox

Caterpillar Tractor Co., Peoria, Ill., unveiled its new Joliet, Ill. plant at an open house in May. This plant, the newest of the company's facilities in operation, was built to produce earth-moving equipment and tractor accessories. Construction began on March 3, 1950, and the first product was produced less than a year later on February 12, 1951, even though the plant was not entirely completed. The manufacturing building covers 662,400 sq. ft.; this will be extended early next year to provide for a total manufacturing area of 891,000 sq. ft. A parts department will also be established at this plant when a 283,000 sq. ft. building is completed in 1953.

"Caterpillar Week" was proclaimed in May by the Mayor of Joliet in observance of the official introduction of the new plant to citizens of the area. During this week the plant was open to the public from 9 a.m. to 9 p.m.

Nordberg Mfg. Co., Milwaukee, Wis., has appointed the Olson Equipment Co., Minneapolis, Minn., as distributor for the 4FS diesel engines in Minnesota and northwestern Wisconsin.

Euclid Road Machinery Co., Cleveland, Ohio, announces the election of Stewart F. Armington, vice-president of engineering and one of the founders of the company, as chairman of the board. He succeeds his father, C. A. Armington, who was elected honorary chairman. G. E. Armington succeeds Stewart Armington as vice-

president of engineering, and Hugh T. Monson, formerly factory manager, has been named vice-president of manufacturing. E. H. Newby, who has served as advertising manager and personnel director, has been elected vice-president, controller. Other officers re-elected are R. Q. Armington, president; E. F. Armington, vice-president of sales and secretary, and J. L. Hinckley, treasurer.

Johnston Pump Co., Pasadena, Calif., announces that at a special meeting of the board of directors, Thomas W. Simmons, Jr., was elected president and general manager of the company. According to Mr. Simmons, who was formerly vice-president and general manager, there will be no change in the company's policies or plans. Other directors of the company are Mrs. Mabel C. Simmons, chairman of the board; Earl Hupp, who is also secretary-treasurer; Charles L. Holbert, vice-president in charge of finance; and Warren S. Pallette, general counsel.

Thomas W. Simmons, Jr.

Westinghouse Electric Corp., Pittsburgh, Penn., announces the appointment of F. D. Weatherholt as sales manager of industrial products. He was formerly manager of the apparatus division's industrial department at East Pittsburgh.

Quaker Rubber Corp., division of H. K. Porter Co., Inc., Philadelphia, Penn., has established a branch warehouse and sales office in Cincinnati, Ohio, under the supervision of W. W. Hutchinson, who formerly covered the Toledo territory.

Macwhyte Co., Kenosha, Wis., has announced the death of Jessel S. Whyte, president and general manager of the company. He was 61 years old. Born in Chicago, Ill., Mr. Whyte was educated at University high school, Chicago, and Cornell University, Ithaca, N.Y. He joined Macwhyte Co., in 1905 in the winding department when the plant was located in Coal City, Ill. Later he studied at Sheffield University, Sheffield, England, and served his apprenticeship in metallurgy at Bruntons Wire Mills, Musselburg, Scotland. He returned to Macwhyte Co. as foreman in the wire mill in 1914. The company was moved to Kenosha in 1912 and Mr. Whyte soon became wire mill superintendent. In 1916, he was elected a director and was general superintendent and a director of the company in 1917 when he left for army service. Two years later he returned to Macwhyte Co. as general superintendent. He was appointed vice-president in 1927 and in 1929 became vice-president and general manager. He had been president and general manager since 1937.

Gar Wood Industries, Wayne, Mich., has appointed James E. Edelbrock as manager of the Chicago factory branch. He replaces Ross Miller who has been named vice-president and general manager of National Lift Co., Waukesha, Wis., a subsidiary.

Link-Belt Co., Chicago, Ill., announces the appointment of James H. Oakes, former sales manager for enclosed drives, as sales manager for the Philadelphia plant, and Byron K. Hartman, former assistant sales manager at Philadelphia, as sales manager for the new Colmar plant.

Rust-Oleum Corp., Evanston, Ill., has appointed the following distributors: Galen Paint Co., Toms River, N.J.; Metropolitan Paint Co., Washington, D.C.; Industrial Equipment & Engineering, Pittsfield, Mass.; Summers Hardware & Supply Co., Johnson City, Tenn.; Masek Auto Supply Co., Inc., Gering, Neb., and Casper, Wyo.; The Adkins & Douglas Co., Hurlock, Md.; Stebbins-Anderson Co., Inc., Towson, Md.; Parsons Bros., Inc., Bridgeport, Conn.; Carey Bros., White Plains, N.Y.; M. A. Hartnett, Inc., Dover, Del., and Superior-Sterling Co., Bluefield, W. Va.

Flexible Steel Lacing Co., Chicago, Ill., has announced the appointment of John P. Ramsey as sales manager to succeed Hugh L. Coats who will continue his work as secretary and director of the company.

Bemis Bro. Bag Co., St. Louis, Mo., announces that P. C. McGrath, formerly sales manager of the St. Louis sales division, has been appointed assistant manager of the St. Louis bag factory and sales division. R. W. Lahey, Jr., who has served as assistant to the superintendent of Bemis Southeastern sewing machine service department at Norfolk, Va., has been assigned to the newly created position of textile and paper bag specialist at Norfolk. A. N. Weeks, manager of the plant at East Pepperell, Mass., and R. J. Williams, machine design section of the general engineering department at St. Louis, have returned from a tour of Europe where they inspected paper bag making equipment and methods in England, Scotland, Belgium, Germany, France and Italy.

Dewey & Almy Chemical Co., Cambridge, Mass., announced the death of Arthur B. Summers, sales engineer for the construction specialties division. He was 57 years old, and was widely known among highway officials and engineers in the construction field.

Pettibone Mulliken Corp., Chicago, Ill., has announced the appointment of K. Ray Merrick as district manager of the construction equipment division, covering the states of Michigan, Indiana, Illinois, Missouri, Kansas and a portion of Arkansas. He replaces C. W. Stewart who has been transferred to the newly created California territory, which comprises the northern half of California, Nevada, Oregon and a portion of Idaho. Alex E. Ainlay has been appointed district manager in the newly created territory comprising the states of Colorado, Wyoming, Utah, eastern Idaho and a portion of New Mexico, and Arnold C. Lee has been named district manager of the newly created territory covering the states of Washington, Montana, a portion of Idaho, Alaska and the Canadian provinces of British Columbia, Alberta and Saskatchewan.

The Kirk & Blum Mfg. Co., Cincinnati, Ohio, recently honored 40 employes who have been associated with the firm from 25 to 44 years, at a dinner which also commemorated the company's 45th anniversary.

Caterpillar Tractor Co., Peoria, Ill., announces that William H. Franklin, controller, has been elected a vice-president in addition to handling the duties of E. Bornstein, secretary, who has retired after 30 years of service with the company. A. N. Whitlock, assistant controller, succeeds Mr. Franklin as controller.

Cummins Engine Co., Inc., Columbus, Ind., announces that Harold H. Hall, formerly general service manager, has been appointed general manager of the Cummins Diesel Export Corp., with headquarters at Columbus, Ind. Charles C. Sons, formerly eastern service manager, has been named acting general service manager for Cummins Engine Co., succeeding Mr. Hall. W. B. Lawrence has been elected a vice-president of the Cummins Diesel Sales Corp., Columbus, Ind., in addition to his duties as general manager of the eight dealerships operated by the sales corporation.

Quaker Rubber Corp., division of H. K. Porter Co., Inc., Philadelphia, Penn., has opened a branch warehouse and sales office in Dallas, Texas, under the direction of D. C. Hahn, district manager.

U. S. Electrical Motors, Inc., Los Angeles, Calif., has expanded its manufacturing and servicing facilities for Varidrive and Syncrogear motors with the addition of five buildings within a radius of one mile of the principal plant on East Slauson Ave., Los Angeles. This expansion does not affect the several million dollar development of the defense division plant to be erected on Santa Ana Freeway

between Anaheim and Buena Park. Recent expansion of the Atlantic plant at Milford, Conn., has doubled its previous capacity.

Marmon-Herrington Co., Inc., Indianapolis, Ind., celebrates its 21st anniversary this year with the announcement of a completely new line of heavy-duty all-wheel-drive trucks, known as the "600" Series, ranging from 139 to 180 hp. The company was founded in 1931 by the late Walter C. Marmon and Arthur W. Herrington.

Chase Bag Co., Chicago, Ill., announces that the Chamber of Commerce of Reidsville, N.C., as a means of expressing its appreciation for the firm's contributions toward the growth and progress of the city, sponsored a banquet recently at which F. H. Ludington, president, and key personnel of the Reidsville branch were guests of honor. The Reidsville branch was responsible for producing practically all bags in which vital silica gel was packed for the armed services during World War II.

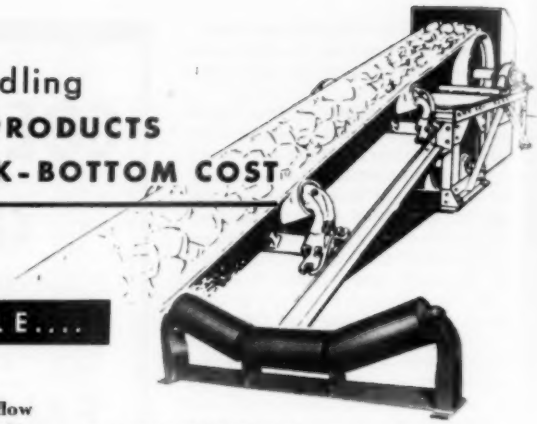
Kent Machine Co., Cuyahoga Falls, Ohio, has announced that C. R. Gifford of Kearny, N.J., has severed his relationship as eastern representative. Hereafter manufacturers of concrete block are requested to communicate directly with the home office which will furnish complete literature and send engineering representatives to discuss problems of prospective purchasers.

Worthington Corp., Harrison, N.J., has named Roy Carter as manager of the volute pump section. He joined the engineering department in 1923 and has been with the centrifugal pump division since 1932. L. H. Garnar has been appointed manager of the process pump section. He joined the centrifugal pump division in 1930. I. J. Karassik has been made manager of the multi-stage pump section. He joined the company in 1934 and has been with the centrifugal pump division since 1935.

Hercules Steel Products Corp., Galion, Ohio, has signed an agreement to manufacture the complete Willard line of portable concrete handling equipment, consisting of concrete mixers, weigh-batch loaders and conveyors, for distribution in all states bordering on and east of the Mississippi river. Announcement of the agreement between Hercules and Willard Concrete Machinery Co., Ltd., Lynwood, Calif., was made by E. P. Monroe, president of Hercules. The Willard Concrete Machinery Co. is expanding its distributor organization in the territory which will be supplied from the Hercules plant, and will maintain an office in Galion.

Link-Belt Co., Chicago, Ill., has announced the appointment of George A. Most, Jr., as district manager at Moline, Ill. He succeeds Stuart T. Penick who has been appointed sales engineer to specialize in power plant coal handling equipment at the new Cedar plant.

S-A for handling ROCK PRODUCTS at ROCK-BOTTOM COST



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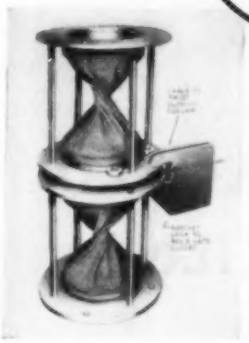
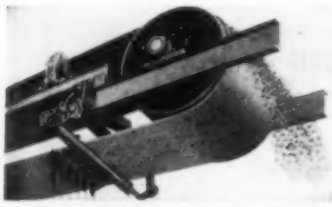


"TWISTITE" BIN VALVES
For dust-tight, dribble-proof bin flow control of both lump and fine materials. Rubber sleeves twist for a tight seal, by means of either hand or motor control, local or remote. When gate is open the two rubber sections, joined by a rotating collar, allow free flow. Write for Bulletin 254-A.

S-A BELT CONVEYORS
Engineered and built to withstand heavy duty service in moving large volumes of materials at low cost per ton. Available in a wide variety of sizes and arrangements—to meet specific operating conditions. Ask an S-A engineer for full details, or write for Catalog 146.



CONVEYOR BELT CLEANER
Pays for itself by prolonging belt life. Removes wet or dry material, leaving surface of belt clean and dry. Installs easily on any belt conveyor. No moving parts—no power is required. Write for Bulletin 651.

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DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

CUSTOM-BUILT KILNS—COOLERS—DRYERS

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Leading plants everywhere use Webber-quality New and Rebuilt machinery and equipment for guaranteed production investment.

Quotations and delivery schedules on request

GUARANTEED REBUILT AND RECONDITIONED MACHINERY AND EQUIPMENT

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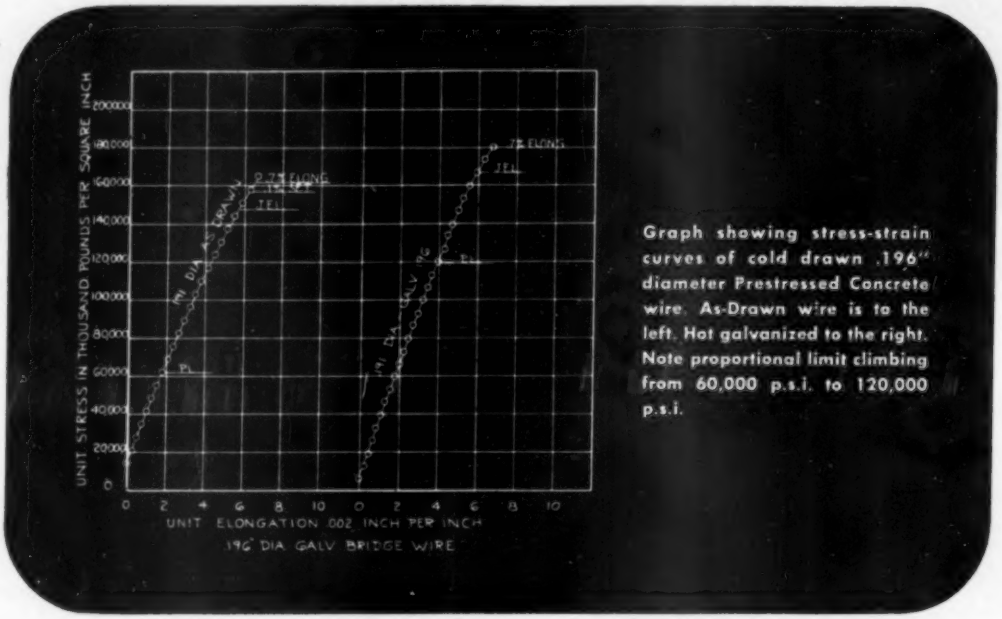
CONCRETE PRODUCTS

ONCRETE UNITS · READY-MIXED CONCRETE

Resort hotel built with pumice concrete masonry units

PRESTRESSED CONCRETE



Graph showing stress-strain curves of cold drawn .196" diameter Prestressed Concrete wire. As-Drawn wire is to the left. Hot galvanized to the right. Note proportional limit climbing from 60,000 p.s.i. to 120,000 p.s.i.

Why you should use hot-dipped galvanizing

SURFACE PROTECTION is *not* the chief reason to specify hot-dipped galvanizing on your post-tensioned Prestressed Concrete projects. It's true that this method gives the best protective coating against corrosion. More important, however, hot-dip galvanizing of the acid steel relieves the wires and raises their elastic properties considerably above those of cold drawn wire.

This wire permits the use of design-tension stress of 120,000 p.s.i. Used at this value, you are always working in the elastic range of the wire itself. And we can guarantee absolute stability with no relaxation of the steel . . . your assurance of safety for the life of the structure.

Each length of Roebling Prestressed Concrete Strand is made into an assembly at the factory with the use of specially designed fittings. Each fitting develops the full breaking strength of the strand without exceeding the yield point of the material in any part of the fitting. Each assembly is then proofloaded in excess of the recommended design-tension stress.

At the construction site the use of an inexpensive hydraulic ram brings the strand assemblies to stress in minutes, cutting the on-the-job labor costs to a minimum. And you never need worry about costly take-ups either.

Strand for post-tensioning is just one of a full line of Roebling Prestressed Concrete products. Wire and strand for *pre-tensioning* are made of high tensile acid steel that results in exceptionally high elastic characteristics. They are specially treated to greatly increase their bonding quality, too.

We manufacture our own prestressing materials. We know they will deliver all we promise and more. Get the facts and figures on Roebling Prestressing materials. Write Prestressed Concrete Department, John A. Roebling's Sons Company, Trenton 2, New Jersey.

Roebling Prestressed Concrete Strand and its specially developed fitting which are available in a complete range of sizes from 5/8" to 1-9/16". With an inexpensive hydraulic ram, assemblies such as these can be brought to stress in a matter of minutes.

ROEBLING

ATLANTA, 934 AVON AVE. • BOSTON, 51 SLEEPER ST. • CHICAGO, 5525 W. ROOSEVELT RD. • CINCINNATI, 3253 FREDONIA AVE. • CLEVELAND, 701 ST. CLAIR AVE., N. E. • DENVER, 4881 JACKSON ST. • DETROIT, 915 FISHER BLDG. • HOUSTON, 6216 NAVIGATION BLVD. • LOS ANGELES, 5340 E. HARBOR ST. • NEW YORK, 19 RECTOR ST. • ODESSA, TEXAS, 1920 E. 2ND ST. • PHILADELPHIA, 230 VINE ST. • SAN FRANCISCO, 1740 17TH ST. • SEATTLE, 900 1ST AVE. S. • TULSA, 321 N. CHEYENNE ST. • EXPORT SALES OFFICE, TRENTON 2, N. J.

INDUSTRY NEWS

New La-Lite Block Corp. plant at Lake City, Tenn.

New Block Plant

THE ACCOMPANYING PHOTOGRAPH shows the new plant of La-Lite Block Corp., Lake City, Tenn. The plant is arranged for truck delivery of expanded aggregate which is fed into the truck ramp hopper from which it is elevated into the aggregate bin. The bin extends through the roof of the building and is located directly over the Besser mixer to serve the Besser block machine.

Bulk portland cement is received by railroad and unloaded through an undertrack screw into the vertical cement elevator shown in the background. This elevator is centrally located between the two cement bins, selectively serving each. The large capacity cement bin in the background is located directly over the undertrack railroad screw so that the reserve cement may be recirculated back through the vertical elevator into the cement batching bin which also pierces the roof of the building.

Heat-Resistant Concrete

THE MUNICIPAL AND AIRPORT DIVISION of American Road Builders' Association recently published in *Technical Information Digest* a summary of a report on recent research on the development of a heat-resistant concrete for jet test cells. According to the report, the General Electric laboratories at Lockland, Ohio, have successfully developed an aluminous cement concrete for jet test cells which will withstand temperatures well above 2000 deg. F.

Ready-Mixed Concrete Price Increase

OFFICE OF PRICE STABILIZATION, under Supplementary Regulation 108 to the General Ceiling Price Regulation, has granted a 4 percent across-the-board increase in the price of ready-mixed concrete, effective as of June 24, 1952. The increase will amount to approximately $.40 to $.50 per cu. yd. SR-106, issued June 24, authorized ready-mixed concrete producers to add to their ceiling prices the increased cost of inbound transportation. A producer cannot apply both increases, but must choose between SR-106 and SR-108. He may elect to use whichever of the two orders that affords him the greatest price relief.

Supreme Court Rules Against Besser Leasing System

A DECISION by the United States District Court for the Eastern District of Michigan, Southern Division, now requires Besser Manufacturing Co. to sell concrete block machinery to any operator presently leasing the equipment, if the operator wishes to do so. This judgment was affirmed by the United States Supreme Court. A portion of the judgment reads as follows:

"Each person presently leasing a concrete block making machine from the defendant . . . may, at its option,

(1) Terminate the said lease agreement at any time prior to January 1, 1953, or

(2) Continue under the terms of the lease, or

(3) Enter into an agreement to purchase the machine or machines leased, and the accessory equipment used, as mutually satisfactory to the parties concerned . . ."

In addition, Besser is required to sell repair parts "upon reasonable, uniform and non-discriminatory prices, terms and conditions of sale."

Cover Picture

AN OUTSTANDING EXAMPLE of concrete masonry construction in California is the Rancho Rafael resort hotel near Ignacio in Marin county. The group of buildings, constructed in 1949, used hollow pumice concrete block reinforced with steel. The units were supplied by Aggrelite Co., Oakland, Calif.

ZUFELT READY MIX CONCRETE CO., Mesa, Ariz., has been purchased by Kenneth G. Bentson and Bill Hazellett of Phoenix, and Gene Hancock of Mesa, who will operate the plant under the name of Mesa Union Concrete Co.

JOHN A. WHITMAN & SON CINDER AND CEMENT BLOCK FACTORY, Midland, Mich., has been purchased by Louis Jablonski and James Dean.

LAWSON BRIKCRETE, Weiner, Ark., has been sold to Charles Givens and Raymond Cart and will be operated under the name of Poinsett Building Products Co. Mr. Lawson, former owner, will remain with the new company.

AMERICAN CONCRETE PIPE ASSOCIATION recently announced the establishment of an office at the Edmonds Building, Room 808, 917 Fifteenth St., N.W., Washington, D.C. John A. Ruhling is in charge of the regional office.

G. C. MCBRIDE CO. has announced the removal of its main office from Waco to Brownwood, Texas. The company's name was changed recently from the Waco-Tex Materials Co.

NEVADA CONCRETE PIPE CO., Sparks, Nev., recently installed a new pipe manufacturing machine, which will enable the company to meet the demands of private customers. Formerly the company produced concrete pipe for contractors only. The company produces pipe for irrigation, sewers, culverts and drainage. in sizes ranging from 8 to 48 in. in diameter.

FORT WORTH SAND & GRAVEL CO., Fort Worth, Texas, is moving equipment to Arlington, Texas, for the establishment there of a concrete batching plant.

ECONOMY CAST STONE CO., Richmond, Va., is supplying 160 "concrete torpedoes" for the Navy. The torpedoes are dummies used in training work and have hooks so they may be attached to airplanes and dropped over targets.

SOUTH HAMMOND COAL AND MATERIAL CO., Hammond, Ind., has changed its firm name to South Hammond Concrete Products Co.

STANLEY SAGER has established a ready-mixed concrete plant at Enterprise, Ore. Equipment includes a 2-cu. yd. transit mixer truck.

SACRAMENTO READY MIX CO., Sacramento, Calif., was recently organized by Louis Jansen and R. Melvin Pottenger. A new plant has been built and placed in operation. Facilities include a conveyor; a 4-compartment, 150-ton capacity aggregate bin; a 500-bbl. capacity cement storage silo; and a pumice block office building.

EL MONTE READY-MIX, INC., recently began operations at its new ready-mixed concrete plant at Elma, Wash. Equipment includes a batching plant and two trucks equipped with 3-cu. yd. Challenge mixers.

Saved—A $10,000 Form-Set

ON EACH OF TWO NEW MIAMI BEACH HOTELS

● Recent additions to Miami Beach's galaxy of fine oceanside hotels are the Lombardy and the Emerald Isle . . . both all-concrete structures . . . fire-safe, durable, attractive.

As canny as it is sunny, Miami Beach gets maximum value out of the hotel-building dollar. Both of these distinguished hotels were concreted throughout—frame, floors, roof—with 'Incor' 24-Hour Cement.

Scheduled construction took fullest advantage of dependable 'Incor' high early strength, with these newsworthy results in savings of time, money and materials:—

(1) From blue print to occupancy in 150 working days on the 153-room Lombardy . . . a similar record on the 110-room Emerald Isle;

(2) Top construction speed with one set of forms on each hotel . . . saving on each building the cost of an extra $10,000 form-set which would have been required for equal speed with ordinary cement.

Across the country, this same 'Incor'* economy attribute is now serving in defense construction of all types . . . saving critically short materials...saving time and money, too.

*Reg. U.S. Pat. Off.

LOMBARDY HOTEL, Miami Beach
EMERALD ISLE HOTEL, Bal Harbour
(north of and adjacent to Miami Beach)

Architect: **ROY F. FRANCE & SON**

Contractor: **TAYLOR CONSTRUCTION COMPANY**

'Incor' 24-Hour Cement from:
ALFRED DESTIN COMPANY

—all of Miami Beach, Florida

HERE'S WHY THEY ASK FOR 'INCOR'

What does a set of forms cost today? Plenty! Get twice as many re-uses and you cut form costs in half. Here's a sure way you can save money. Use 'Incor' concrete . . . fill forms, strip and re-assemble in 24 hours. One form set does the work of 2 or 3 as formerly required.

Dependable 'Incor' high early strength assures maximum job speed, saves time and overhead . . . with 50-60% less forms. Good reason why so many users ask for 'Incor'—and why so many Ready-Mix Operators make 'Incor'* concrete available as part of their good service.

LONE STAR CEMENTS COVER THE ENTIRE CONSTRUCTION FIELD

LONE STAR CEMENT CORPORATION

Offices: ABILENE, TEX. • ALBANY, N. Y. • BETHLEHEM, PA. • BIRMINGHAM
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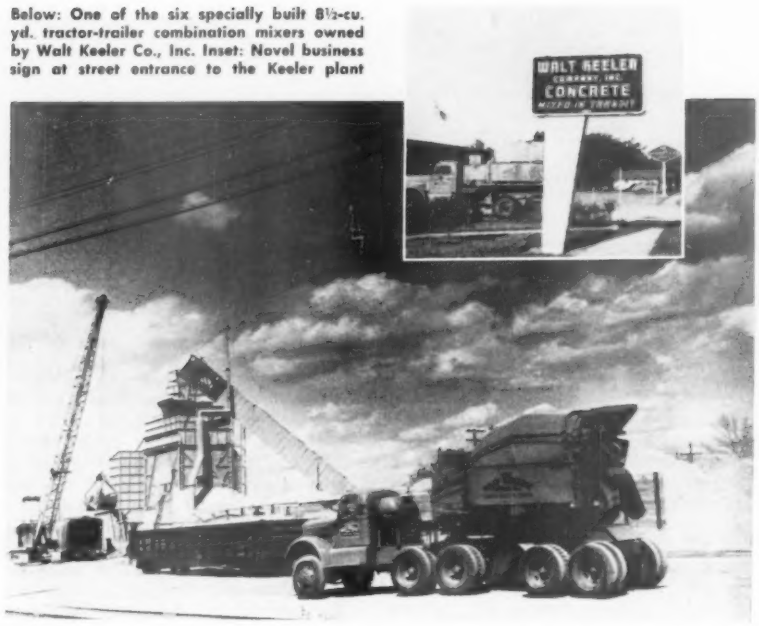
LONE STAR CEMENT, WITH ITS SUBSIDIARIES, IS ONE OF THE WORLD'S LARGEST CEMENT PRODUCERS: 17 MODERN MILLS, 125,600,000 SACKS ANNUAL CAPACITY

Below: One of the six specially built 8½-cu. yd. tractor-trailer combination mixers owned by Walt Keeler Co., Inc. Inset: Novel business sign at street entrance to the Keeler plant



Four companies with eight plants have built a name for efficient service. War-born industries accelerated growth

By TIP BROWN

READY-MIXED CONCRETE INDUSTRY MUSHROOMS IN WICHITA

CROSS COUNTRY TRAVELERS who pass through Wichita, Kan., rarely fail to register surprise at the extent of air facilities, homes and commercial buildings that spread out over the landscape of this inland air capital. The population has increased more than three-fold in a quarter of a century. Without the building industry, much growth would have been impossible. Among them all, none occupies a higher rating than the concrete industries. Below the surface, miles of concrete pipe serve drainage and sanitary needs; street paving, sidewalks, runways, parking areas, ramps and taxiways occupy acres of land surface; structural concrete accounts for many thousand cubic yards and concrete masonry has supplied vast quantities of block for houses and a variety of commercial buildings.

Ready-mixed concrete has played a leading role in a continuous building program that has been underway for two decades. Often confronted with impossible performance, the industry has earned a position of public confidence and respect.

Wichita Air Base

The Municipal Airport, six miles southeast of the city, has been the center of interest for air-minded Wichitans. Near neighbors to the airport are the Beech Aircraft Corp. and Cessna Aircraft Co., both manufacturers of civilian and military planes and parts, and the giant Boeing Airplane Co., a major producer of military aircraft in World War II and currently producing the B-47 jet bomber. Four commercial airlines use the Municipal Airport and in 24 hr. there is an average of 35 flights. Freight cargo during the same period is an average of 2½ tons.

More than a year ago the Municipal Airport facilities, including land, buildings and runways, were acquired by the Wichita Air Base, a U.S. Air Force training school for B-47 fliers. Transfer of the commercial air operations awaits completion of a new municipal airport on a 2400-acre site, 5½ miles southwest of the city. Runways are now being constructed and buildings and other facilities will next be built.

The Wichita Air Base added two sections of farm land to the original field, and in June, 1951, a construction program began to provide facilities for an eventual 6000 personnel and students and for parking and servicing of aircraft. Among the many projects is a recently completed B-47 parking area which consists of 88 acres of concrete runways 17 in. thick in the center and 24 in. thick on the edges.

The construction industry has moved fast in building underground and above-ground facilities to provide sanitation, paving, warehousing, work and living quarters for the base personnel. Placing concrete on such a huge scale far exceeded the local commercial facilities for furnishing ready-mixed concrete, and the paving contractors, generally, set up their own mixing plants. The ready-mixed concrete companies supplied the building jobs.

Housing

Housing the families of personnel attached to the base and the 50,000 civilian workers now employed in the aircraft and subcontracting plants has been a phenomenal accomplishment, starting at the time of the great defense plant activities of the early 40's. Wichitans are accustomed between seasons to notice the disappearance of a wheat field or a golf course and in its place a square mile of new homes taking form—usually one story, basementless, single or multiple dwellings. In lieu of individual garages, frequently paved parking areas at the head of a street provide open air storage for a half dozen cars. A current development nearing completion adjacent to the air base involves 1040 houses. Shopping centers are built in the larger housing areas, resulting in innumerable villages.

Evolution of Concrete Industry

A quarter of a century ago, Wichita was a thriving commercial center of 75,000 people who were content to be in the largest town in the state and who leisurely contemplated the future of being metropolis to a rich agricultural empire of wheat and livestock. Even then, there were sub-

Truck fleet of Allen's, Inc.

stantial local interests in milling, meat packing and jobbing. A few years later oil was found over a large part of the trade territory, and even in the immediate vicinity of Wichita. This brought with it a need, and also the funds, for paved highways.

Street paving contractors in the city found they could speed up operations on certain portions of the work by dry mixing materials and hauling to the site, and still later by establishing central-mixing plants and hauling the mixed concrete to the jobs in dump trucks. The Mixed Concrete Supply Co. was formed by Hale T. Ritchie, a leading paving contractor, and some of his associates in 1928. Afterward, Globe Construction Co. established a dry batching plant and at the present time employs six transit mixers in its own paving work.

City specifications for curb and gutter, sidewalks and approaches have for many years required cement and sand mixtures of 1:3 or 1:3½. The quality of the local Arkansas river sand is such that it is easy to obtain a fineness modulus of from 2.90 to 3.40. Construction of buildings in the area always has employed the conventional cement, sand and stone mixes.

The Mixed Concrete Supply Co. almost from the start found it difficult to confine deliveries to its own jobs. The commercial business finally could no longer be ignored when a new oil field was discovered at Valley Center, Kan., in 1929. Demand for concrete sky-rocketed, but the oil producers bucked at the cost of $35 for a cubic yard of concrete. Central-mixed concrete from Wichita seemed a likely answer to the problem. It was hauled 12 miles in dump trucks with no serious segregation and delivered in the oil field at $17-$18 per cu. yd., to the great satisfaction of the oil men and with satisfactory profit to the seller.

New Mixing Method

Central-mixed concrete remained in use until the beginning of the depression days in 1931. Sales then fell to an insignificant amount, as did most other commodity sales at the time. Almost at a low point in the depression, a couple of 2½-cu. yd. transit mixers mounted on Indiana trucks made their appearance in Wichita. They had been brought in from Oklahoma by Dolese Bros., large stone and material producer in that state, and a company active in the distribution of building materials in Wichita since 1924 as well as a producer of limestone at Eldorado, Kan. The trucks marked the beginning of a new industry that in less than 20 years has kept pace with the transformation of Wichita into a city of 240,000 people.

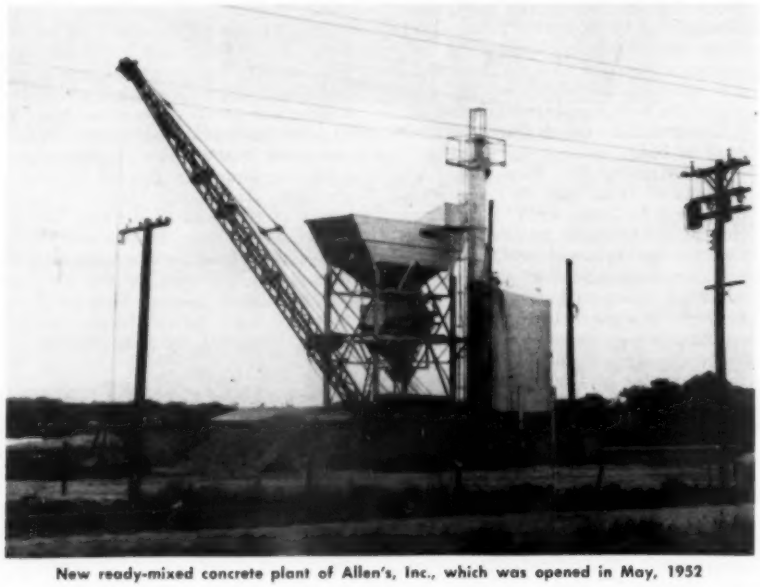
An Industry Grows Up

The pavers continued to supply their own needs through dry batching and site-mixed concrete, but the commercial demand expanded through the years until today there are four companies with eight plants serving the greater Wichita area. Dolese Bros. Co., has central, north and southwest plants; The Walt Keeler Co., Inc. has a central and a south plant; Allens, Inc., operates from a central plant and a new operation in a suburban southeast location. A recent newcomer, Broadway Lumber and Supply Co., has a plant north of the city.

Collectively, the industry has some 90 transit mixers in daily operation and 2000 cu. yd. of ready-mixed concrete constitutes an average day of deliveries. This involves approximately 3000 bbl. of cement, all of which arrives by rail from cement plants in eastern Kansas. The cement moves almost entirely in bulk covered hoppered-bottom cars. Storage of cement, sand and stone at Wichita plants is figured on reserves of one day's needs. This is possible because of the accessibility of cement and aggregate and the dependability of well established delivery facilities.

Sand is found in great abundance in the surrounding area and plants for excavating and loading from open pits are equipped with washing facilities. Other sand plants are located on the Arkansas river which flows through the city. Practically all the limestone now comes from a quarry at Moline, Kan., 100 miles southeast of Wichita. It moves by rail in open top bottom-dump cars or in gondolas.

More than 200 people are employed in the ready-mixed concrete industry, exclusive of those working in the sand plants owned by the various ready-mix companies. The investment in mixers, bins, equipment, garages, real estate and other requirements of the business is estimated on the conservative side at $2,500,000-$3,000,000. With the advantage of quick service in deliveries and freedom from stockpiling on the job, the ready-mixed concrete industry has moved forward constantly, maintained plants and equipment on an efficient basis, and built an excellent name for itself in a locality where speed in construction is always paramount.



New ready-mixed concrete plant of Allen's, Inc., which was opened in May, 1952

Left: O. F. Morse watches lift truck operator pick up eight concrete slabs from the floor of the special shapes department en route to the curing yard. The slabs weigh an average of 200 lb. each since they are flat and of full cross section. U-shaped reinforcing rods are used to clip the slabs together to prevent their falling off. Right: Loading a company-owned tandem trailer with 150 slabs

PRECAST CONCRETE FLOOR AND ROOF SLABS

Morse Cement Tile Co., North East, Penn., simplifies handling of precast reinforced concrete slabs by use of fork lift trucks

MORSE CEMENT TILE CO., North East, Penn., is a small producer of reinforced concrete floor and roof slabs. The bulk of its production, which amounts to 74,000-75,000 lb. per day, is for industrial, commercial and public building construction. Average weight of the slabs is 200 lb., though specials vary more or less according to the job specifications. Fifty men are employed by the company.

Production

Slabs are made in oiled metal forms, adjustable to meet different size requirements. These are stacked flat by overhead crane and left to cure overnight. The next day forms are stripped, the slabs being placed on edge on 2- x 4-in. wood blocks to allow for fork lift truck loading. Two LT-60 Towmotor lift trucks are in service. These carry a load of ten slabs per trip to the 6½-acre paved storage yard. A ten day curing period is usually allowed before shipping or installation of the slabs.

All slabs are made as ordered, though most are stock sizes. There is no inventory storage beyond the 10-day curing period except in a case of delay in construction of a customer's building to a point where it affects his ability to accept shipment. Bagged cement is received by rail and unloaded by hand. Aggregates are brought in either by truck or rail.

A standard mix for all slabs consists of 1 part high early strength cement to 3 parts Haydite, plus a very small portion of sand to give workability to the mix and to provide a smooth under surface on the finished slab. Two 13-cu. ft. Multiplex paddle-type mixers are used.

Slab Handling

Before use of the fork lift trucks was begun four years ago, the slabs were lifted by hand onto flat-bed 1½-ton trucks and were driven out to the curing yard and stacked there by hand. Shipping was done in much the same way, involving hand loading onto a truck for transfer to railroad cars or trailer truck. In some instances semi-trailers were able to maneuver into position to be loaded directly, but usually the wide lane needed for this was not available if the curing yard was filled near capacity.

After removal from the forms, the slabs are placed on small gauge rail cars. Here the slabs are being unloaded for transportation to the curing yard. These channel-shaped slabs weigh approximately 200 lb.

Each of the two trucks formerly used was assigned a six-man crew. These men loaded the truck by hand, rode with it to the unloading point in the yard and unloaded the slabs, leaning them on end against the existing pile. Man-hours required under this method were 48 per day. Upon installation of the fork lift trucks, man-hours for the same operations decreased to 20. Two men now set slabs on edge in groups of ten for loading at a form-stripping station. One man places 2 x 4's in the yard for the slabs to rest on, and two men drive the lift trucks.

Dan T. O'Brien, vice-president of the company, had observed the efficiency of fork lift trucks during Navy service in World War II and inaugurated the present system.

The loads are usually 2000 lb., consisting of ten slabs. Maximum is 3000 lb. The load of slabs is kept together by U-shaped pinch bands made of reinforcing steel rod. The lift truck is narrower than the slabs, so the lanes in the curing yard can be kept at a minimum. This has resulted in ⅓ greater storage space in the same yard area compared with the former method of driving a 1½-ton truck into the yard. Lift trucks have enabled stacking the slabs two-high, edgewise, with wood blocks again placed between each tier to accommodate forks.

Shipping

All shipments within 300 miles of the plant, which represent 80 percent of the production, go by truck;

(Continued on page 260)

PRECAST CONCRETE AIR RAID SHELTERS

Design of shelters built in Holland during World War II adaptable to other applications

By P. F. VAN DER MEULEN BOSMA*

IN THE SUMMER of 1939 some Dutch concrete products producers started manufacturing precast concrete air raid shelters. The amount of sales was small as most people didn't believe that Holland would become involved in the war. From September, 1939, to May, 1940, the shelters got a better chance and many systems were tried out.

In general two systems were sold, shelters made of reinforced concrete pipe and shelters made of special reinforced elements. A third system using concrete block was imported from Germany after the occupation and was used only for military purposes. The first system was easy and cheap to produce, but the necessary large pipe dimensions often made transportation and building of the shelter difficult.

A better and more gas-tight shelter was developed by the N.V. "De Meteoor," one of the most modern concrete products plants in Holland. The shelter is built of concrete pipe with a diameter of 5 ft. 8 in., a length of 16 in. and a wall thickness of 4½ in. The joints of the pipe were filled with a bituminous paste and the whole was connected by three long bolts. Gas-tight construction of the entrances was achieved by wooden partitions and tarpaulins, stiffened with a wooden framework. The wooden partitions were placed in the extra deep grooves of the pipe. No provisions for ventilation were made. The air volume of every pipe was sufficient to provide oxygen for one person for 1 hr. This shelter was designed to be buried for approximately 75 percent of its height. The entrances were wood-lined trenches. Both types were covered with 2-3 ft. of earth.

Some shelters were made of elliptical pipe with flat bearing surface. Inside dimensions were 75 x 80 in., long axis vertical, and a wall thickness of 4 in. All types of concrete pipe were reinforced with light reinforcing steel mesh. For air raid shelters it is better to use mesh with many light bars instead of mesh with a few heavy bars, when both have the same steel sections. When the light bars are used, the concrete holds together better in the event it cracks as a result of near-by explosions or falling debris.

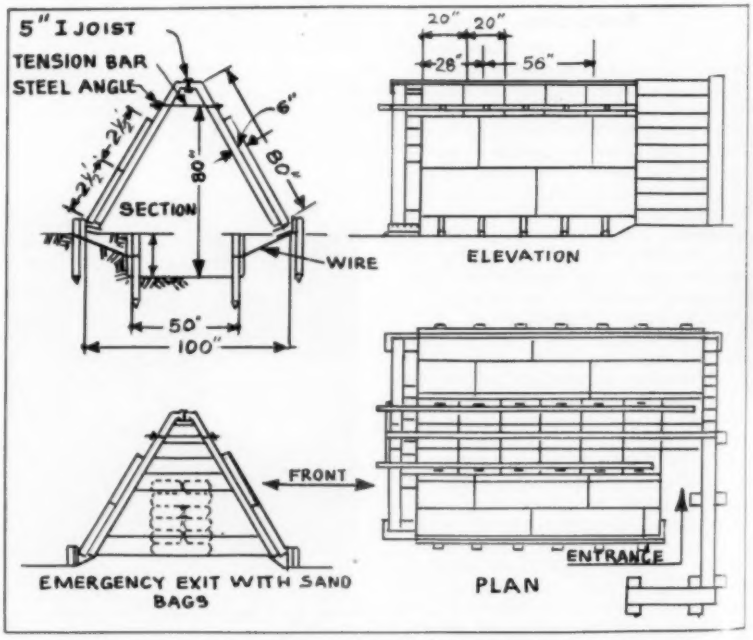
Shelters of precast concrete elements belong to the second system. One type was designed to be used without a sand cover in small backyards, but the war proved that these shelters gave insufficient protection. The Meulenkamp shelters were tested for the town of Rotterdam. The war broke out before the tests were completed, but the shelters were much used. The vertical 20-in. wide slabs could be reinforced with 2- x 5-in. bars with diameters of ¼, ⅛, ⅜ or ½ in. With these reinforcements the slabs were designed to withstand normal loads of 120, 208, 320 and 456 p.s.f., respectively, at an angle of 90 deg. to the surface of the slab. The calculations were made for steel stresses of 25,400 p.s.i. and stresses in the concrete of 1423 p.s.i. The reinforcement of the 2½-ft. wide horizontal slabs consisted of 2- x 7-ft., ¼-in. dia. bars with ¼-in. links spaced 10 in. between centers. The shelters were produced by Duinker en Verruyt of Alphen aan de Rijn under patent No. 92844.

Large quantities of a three hinged arch-type shelter were used by the Netherlands railways to protect station and signal box personnel. These shelters could be made of very simple and light units. No details of the reinforcement can be given. At present the units are used as gravel containers at railway stations. The shelters were produced by Kemper at Ysselmonde, near Rotterdam.

The N.V. "De Meteoor" used retaining walls for the construction of air raid shelters. These shelters were very useful for industries, since the units can be used in peacetime for coal, sand and gravel, fertilizer and other bulk material storage. The wall units are coupled at the top by slabs of concrete, which can also be used to make pavements for fork trucks and other small transportation units. The units are tamped with electric or pneumatic tampers in horizontal steel molds, which are released immediately.

The Germans imported concrete block for their own use. In 1941 production started in Holland and during the war these block were often made with forced labor. The block were placed with mortar when needed and filled with sand or a lean con-

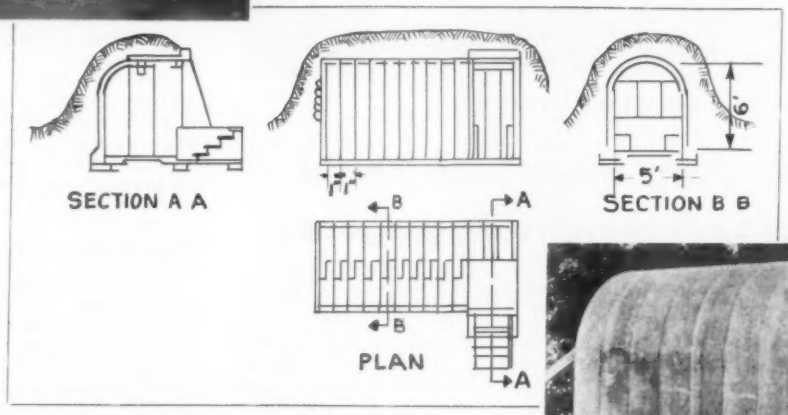
(Continued on page 260)



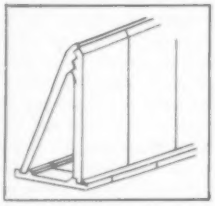
Details of the Meulenkamp shelter, used greatly in Rotterdam during World War II

*Consulting engineer, Meppel, The Netherlands.

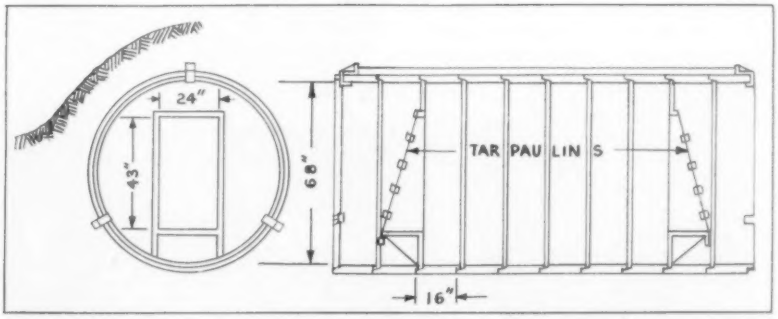
Left: Elements of a Kemper shelter used as gravel containers at a railway station. Below: Construction details of a Kemper shelter



Right: Erecting a Kemper shelter. Arch elements are being placed here; floor slabs are in foreground



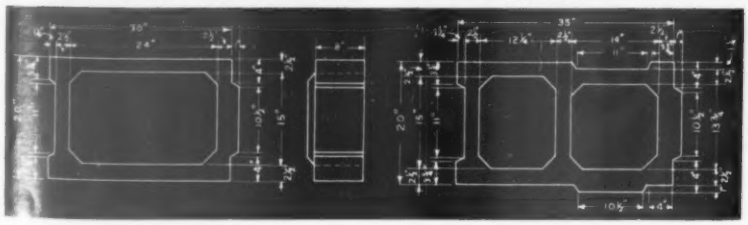
Schematic of concrete wall built by Germans to protect against shell fragments



"Meteoor" shelter built of concrete pipe 5 ft. 8 in. in diameter

Shelter made of retaining walls; note flat steel coupling of corner elements

Types of block made for the German army when occupying Holland



Examples of various types of German block can be seen here, some made with cinder aggregate

Midland plant of Texas Concrete Block Co.

Concrete Units Made with Three Types of Lightweight Aggregate

TEXAS CONCRETE BLOCK CO., upon completion of its new plant at Midland, now has three plants in operation in west and central Texas. The home plant of the company is at Lubbock, and the third operation is at Abilene. The company is owned by three brothers: R. P., E. E. and N. A. Brown. All the plants use Besser Vibrapacs and use low pressure steam curing. The Lubbock plant has two block machines and one is at each of the other plants.

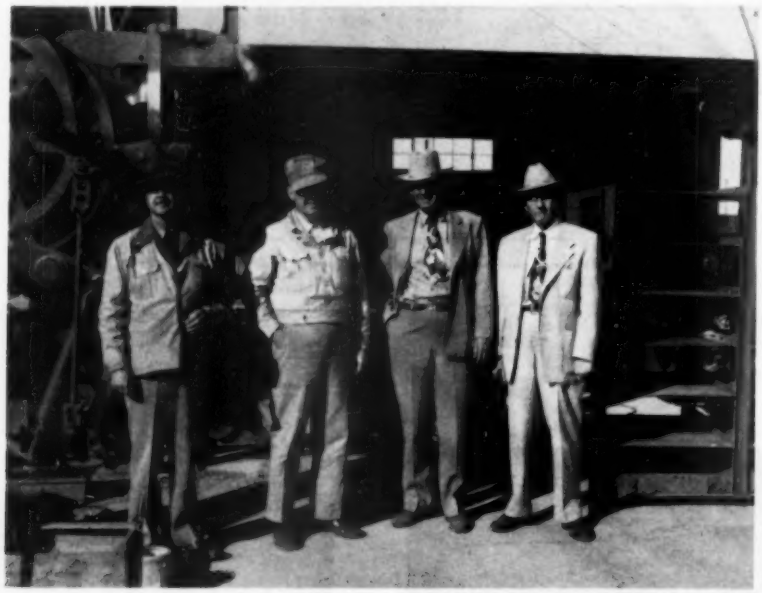
A feature that sets this group of operations apart from many others is the exclusive use of artificial lightweight aggregates at all the plants. The Abilene plant uses Featherlite from the Straun plant of the Featherlite Corp., the Lubbock plant uses a lightweight product made by American Aggregates Co., Ranger, Texas, and the new plant at Midland uses Haydite made at Eastland, Texas, by Texas Lightweight Aggregate Co., one of the subsidiaries of Texas Industries, Inc., Dallas. All of these lightweight aggregate plants are west of Dallas and in the same general area. No hard aggregates or natural lightweight materials are used at any of the plants.

At Midland the Haydite is unloaded into a track hopper and a bucket elevator carries the material into an overhead storage bin. A second bucket elevator handles the bulk cement. The plants all have 50-cu. ft. Besser mixers. The plant is located on the Texas and Pacific railroad, a branch of the Missouri Pacific railroad.

The company makes truck delivery using its own equipment. A White flat rack and a GMC flat rack are available, both 32-ft. tractor drawn semi-trailers. A bob-tail truck is also available. In the yard the company has two Truck-Man and two Hyster 40 lift trucks.

Midland, Texas, is a modern city of 35,000 population. Due to the rapid growth of the oil industry in the area, it is one of the fastest growing cities in west Texas. Texas Concrete Block Co. has had a sales office at Midland for over a year.

Alvin Woody is manager of the Midland operation and M. L. Brooks is sales manager. Daly DeNoyer is office manager. John Barton is manager at Abilene and Alvin Webb is the manager at Lubbock.



The owners and contractors look over the plant under construction: left to right are R. E. Brown, one of the owners; David Wright, Besser representative; Fred Stanton, plant builder; and E. E. Brown, another one of the owners

Truck Mixer Tests

NATIONAL READY MIXED CONCRETE ASSOCIATION, in cooperation with the Truck Mixer Manufacturers Bureau, is conducting a comprehensive investigation of truck mixers at the association's research laboratory at the College of Engineering, University of Maryland.

Concrete mixed at different rates and for different times in full-sized truck mixers is to be tested for strength, consistency and proportions of ingredients. Samples will be taken throughout the discharge of the batch. Studies of the effect of volume of batch, from considerably below rated capacity to considerably above, will also be made. The tests will be carried out over a period of about two months and will involve tests of approximately 100 batches of concrete from standard truck mixers.

To facilitate control, a small aggregate batching plant is being erected on the premises of A. H. Smith Sand and Gravel Co., Branchville, Md., about 2½ miles from the university. Separate stockpiles of aggregate, with the coarse aggregate in two sizes, are being provided with careful attention to reduction in segregation during the stockpiling. Bulk cement will be drawn from a bin belonging to the A. H. Smith company and the same brand of cement will be used throughout the tests.

The investigation will be divided into three groups: the first group will comprise tests with a single horizontal axis truck mixer, involving a detailed study of the principal variables—volume of batch, mixing rate and mixing time; the second group will comprise similar tests in somewhat less detail, with two types of high-discharge mixers; in the third group, several different mixers will be tested in the light of experience gained in the first two groups.

Test results for individual mixers will be kept confidential. The results are to be published in such form so as not to identify the make of the mixer.

CONCRETE IRRIGATION PIPE CAST IN SOLID ALUMINUM FORMS

By WALTER B. LENHART

The pipe plant of Valley Concrete Pipe Co. is at the right of the ready-mixed concrete batching plant, above. Materials are dry batched and then transferred to 50-cu. ft. mixers by the belt conveyor visible in the center

VALLEY CONCRETE PIPE CO. is an affiliate of the Valley Ready Mixed Concrete Co., which has four ready-mixed concrete plants in the lower Rio Grande Valley located from McAllen at the upper end of the district to Brownsville at the mouth of the river. The home office of Valley Ready Mixed Concrete Co. is at Harlingen. The pipe division comprises two plants, one at Harlingen that features the use of the Rocla (Australian) process, and the plant at McAllen. The pipe division operates independently from its office in McAllen.

The plant at McAllen was visited specifically to learn more of the new type, solid aluminum form that is used there for the manufacture of concrete irrigation pipe. This is the first published account of its use. The form is made by Woods Welding & Mfg. Co., Mecca, Calif., and is fabricated from $\frac{3}{16}$- to $\frac{1}{4}$-in. thick aluminum. The single vertical joint is a riveted butt joint. At McAllen 6-in. through 24-in. dia. forms are available. The 14-, 16-, 18- and 24-in. forms are 3 and 4 ft. long. From 12 in. down the forms are 3 ft. long.

Pipe is cast with the tongue end down. The wall thicknesses on the 12-, 16-, and 18-in. units are 1, $1\frac{5}{8}$ and 2 in., respectively. The 24-in. dia. pipe has a wall thickness of $2\frac{1}{4}$ or $2\frac{5}{8}$ in. There is a $\frac{1}{8}$-in. taper in the form, the tongue or lower end being the larger.

Near the base of the form is a trigger that is wrapped about halfway around the form. This trigger is a part of the lower pallet assembly.

One of the 50-cu. ft. mixers for the pipe plant is at left. Materials are batched in the ready-mixed concrete plant adjacent, then delivered to the mixers by belt conveyor. The belt conveyor at bottom delivers to two of the pipe machines

Making a pipe in a solid aluminum form on one of the packerhead machines the company operates

After the pipe has been cast and taken to the curing floor, the operator presses down on the trigger to release the pallet and casting. The two operators next shake the form slightly, causing the suction to break and the pipe (and pallet) to slip downward about an inch. The two workmen then lift the form vertically from the green pipe.

The advantages claimed for this type of pipe are many, among which might be mentioned the use of a wetter mix in the packerhead machine, which in turn means a longer life to the shoes, and a better looking pipe. The forms are cheaper than iron forms but have a slightly shorter wearing life; however, it was said that 150,000 ft. of pipe could be cast from three forms. The forms are light and easy to handle and, still more important, the cast pipe is always round. The butt joint of the form is ground smooth so that the entire surface of the pipe receives a troweling action when the form moves and when it is lifted off the casting. No seams show on the casting.

The plant has two tamper and three packerhead machines, all company-made. The packerheads are the Martin type. Concrete for the plant is supplied from the ready-mixed concrete plant that is adjacent to the pipe plant. The dry batched mix is conveyed from the weigh batcher by short belt conveyors to one of two short belt conveyors serving two 50-cu. ft. Besser mixers. From the mixers belt conveyors radiate out to the different pipe machines. The belts are geared to slow speeds to conform to the pipe machine needs. Only four of the machines are fed by the system of belts, the fifth unit being fed by wheelbarrows. The batching equipment consists of Butler weigh batchers and Ingram Machinery Co. bins.

Aggregates are delivered to the bins from a reclaiming belt conveyor operating in a tunnel. One man at the mixer supplies the four machines. The pipe are cured under sheds and periodically sprayed with water as required.

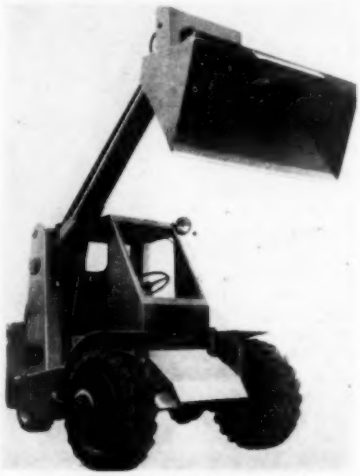
Some pipe have been cast using the pozzolan produced nearby at the plant

(Continued on page 265)

NEW MACHINERY

Front-End Loader

MIXERMOBILE MANUFACTURERS, 8027 N.E. Killingsworth St., Portland, Ore., has introduced the Model H Scoop-mobile, an all-hydraulic front-end loader. The unit has a single boom and comes equipped with a ¾-cu. yd. scoop, has a rated lift capacity of 4000 lb. and a standard discharge height of 8 ft. The loader has Vickers hydraulic steering and is equipped with Mixermobile planetary drive. Attachments include a swivel-type concrete hopper, forks and crane boom.



Single-boom hydraulic front-end loader

Mortar Admixture

AMERICAN POLYMER CORP., Peabody, Mass., has announced development of a vinyl copolymer emulsion, Polyco 470, which when added to portland cement mortars is said to give increased tensile strength and greater extensibility. The manufacturer states that 28-day tests show that tensile strength is increased 3 to 10 times and extensions at rupture are more than 10 times those of ordinary cement mortars with the same water-cement ratio. It is said that the emulsion also aids in curing by slowing evaporation; Polyco 470 also acts as a dispersing agent.

Block Lifter

BLOCK-LIFT CO., INC., 1605 14th St., Cuyahoga Falls, Ohio, has placed in production a concrete block lifter that weighs only 14 oz., compared with 32 oz. for the previous model. The tool is said to fit 98 percent of all line block, but will not pick up halves or three-quarters.

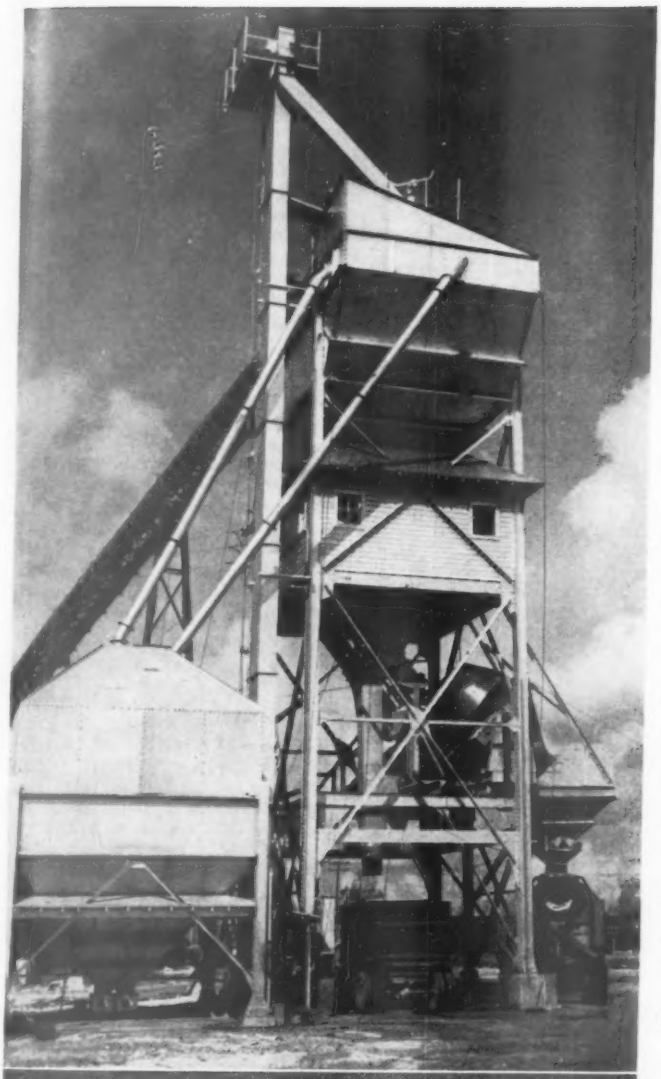
Water Repellent

L. SONNEBORN SONS, INC., Building Products Div., 80 Eighth Ave., New York 11, N.Y., has announced that a silicone water repellent mixture, Hydrocide (colorless) SX, is now available. Applied to exterior concrete and masonry walls, the product is said to produce a water repellent surface and minimize efflorescence. It can be applied by either brush or spray.

Mixer with Truck Engine Drive

THE T. L. SMITH CO., 2835 N. 32nd St., Milwaukee 45, Wis., has announced a truck mixer equipped with truck engine drive, reducing the deadweight of the unit by about 1300 lb. The over-all length is reduced approximately 19 in. and considerable weight is shifted from the rear axle to the front axle. The unit is available in 4½-, 5½-, and 6½-cu. yd. sizes.

Mixer driven by truck engine reduces deadweight



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BUTLER BIN CO.
989 Blackstone Avenue
Waukesha, Wisconsin

Precast Concrete Slabs

(Continued from page 253)

the remainder over 300 miles are shipped by rail. Truck trailers are loaded by the lift trucks, which drive up a ramp onto the truck bed. The length of the slabs prevents the lift trucks from going into railroad cars, so loads are deposited at the car doors and two-wheel hand trucks used to finish loading. Box cars are used rather than flat cars or open-end gondolas. Slabs are placed lengthwise in the car, at least two high.

Personnel

O. F. Morse is president of Morse Cement Tile Co., and Dan T. O'Brien is vice-president and general manager. N. M. Morse and J. M. O'Brien are treasurer and secretary, respectively. George Terko is plant superintendent and George Bradley is shipping manager.

Air Raid Shelters

(Continued from page 254)

crete mix which could be reinforced. These were used on many military building jobs and for walls to reduce the effect of bombs and aircraft bullets on buildings, vehicles, aircraft, transformers, telephone exchanges, etc. The block were made in Holland in steel molds and tamped with electric or pneumatic tampers. This was a laborious task and there is no indication that block machines were used.

When these block were used on air raid shelters, the roof was made of prestressed concrete joists. The reinforcement consisted of many high tensile wires. Concrete was placed over the joists and the whole unit was covered with earth.

Concrete Institute Meeting

THE AMERICAN CONCRETE INSTITUTE is holding its fall regional meeting concurrently with the Centennial of Engineering in Chicago, Ill., September 10-12, 1952. The following papers will be presented at the prestressed concrete session: an introductory paper bridging the gap between the M.I.T. 1951 conference on prestressed concrete and this session, to be presented by Myle J. Holley, Jr., Massachusetts Institute of Technology; "Prestressed Elements of New York Harbor Pier 57," by Capt. E. H. Praeger, Madigan-Hyland; "Prestressed Research in Massachusetts, Epitomized in Construction of the Endicott Street Bridge in Danvers, Mass.," by J. C. Rundlett, Massachusetts Dept. of Public Works; "Construction of the Caracas, Venezuela, Bridge Using the Freyssinet System," by Robert Shama, Freyssinet Co., Inc.; "Prestressed Concrete Machine Foundation Recently Constructed at International Nickel Co., Huntington, W. Va.," by A. M. Klein, Robert W. Hunt Co., New

York, N.Y., and J. H. A. Crockett, London, England; "Discussion of Needed Research in Prestressed Reinforced Concrete," by N. M. Newmark, University of Illinois; "Tampa Bay Bridge Construction Using the Lee-McCall System," by W. E. Dean, Florida State Road Dept.; "Manhattanville College of Sacred Heart—Prestressed Girders in Dining Area," by J. J. Closner, Preload Enterprises, Inc.; "Progress in P.C.A. Research," by a Portland Cement Association representative; and a general summary by Admiral J. F. Jelley, U. S. Navy, Bureau of Yards and Docks.

At the precast and thin-shell concrete design and construction session, the following papers will be presented: "Description of Thin-Shell Design and Construction of New Automobile Salon in Turin, Italy," by Dr. Pier Luigi Nervi, Rome, Italy; "Discussion of Various Aspects of Thin-Shell Design Based on Research for Lehigh University," by Dr. Bruno Thurlimann, former research engineer, Lehigh University, and Bruce G. Johnston, University of Michigan; "Construction Aspects of Thin-Shell Roofs," by Anton Tedesko, Roberts and Schaefer Co.; "Discussion of Construction of Thin-Shell Roofs," by C. S. Whitney, Ammann and Whitney; "Precast Concrete Boxes in New York Harbor Pier 57," by E. H. Praeger, Madigan-Hyland; "Precast Concrete in Highway Bridge Construction," by E. L. Erickson, Bridge Branch, Bureau of Public Roads; and a progress report on fire resistance of concrete floor slabs, by J. P. Thompson, Portland Cement Association.

New Wall Construction

AMERICAN BILDROK CO., Chicago, Ill., has announced the development of a new type of wall construction which recently passed a 4-hr. fire-resistance test at the Underwriters' Laboratories. Advantages claimed for the new wall construction include its lightness, high strength, fire resistance, high insulating value, speed of erection and low cost.

The wall is made from an insulating concrete composed of perlite aggregate and portland cement. The concrete is sprayed in place through a new material handling device called the E-Z-On plastering machine which is said to be capable of building a solid, loadbearing wall 6 in. thick, five times as fast as conventional hand methods.

Western Concrete Products Meeting

THE CONCRETE PRODUCTS ASSOCIATION OF WASHINGTON held its 23rd annual meeting at Harrison Hot Springs, British Columbia, Can., June 13-15.

Representatives from Vancouver, B.C.; Calgary, Alberta; Chicago, Ill.; Denver, Colo.; and Bend and Portland, Ore., in addition to the members and

associates from the state of Washington, were in attendance.

Officers elected for the ensuing year were: Robert W. Condon, Graystone Concrete Products Co., Seattle, Wash., president; B. E. Harrison, Harrison Pipe Co., Tacoma, Wash., vice-president; Verne Frese, Layrite Concrete Products of Seattle, Inc., Seattle, Wash., secretary; and E. E. Cummins, Yakima Cement Products Co., Yakima, Wash., treasurer. The following directors were elected: Talbot Campbell, Seattle Concrete Pipe Co., Seattle, Wash.; George F. Ruth, Longview Concrete Pipe Co., Longview, Wash.; and J. W. Sullivan, Bremerton Concrete Products, Bremerton, Wash.

Among the guest speakers at the convention were R. E. Copeland, director of engineering, National Concrete Masonry Association, and Howard F. Peckworth, managing director, American Concrete Pipe Association.

Mr. Copeland gave a discussion of the manufacture, control and use of concrete masonry, with particular reference to the moisture content of the block at the time it is placed in the wall. He mentioned some federal and state agencies that are specifying a maximum moisture content and he added that some of these agencies had expressed appreciation for the cooperation given by the block industry. Mr. Copeland also briefly outlined the research at Toledo University, which is primarily concerned with moisture and temperature, with particular emphasis on cracking of concrete masonry and its relationship to moisture loss. Other topics discussed by Mr. Copeland included masonry mortars, apparatus for testing the suitability of concrete masonry in terms of relative humidity and overall costs of drying of block.

Mr. Peckworth was the guest speaker at the Saturday evening banquet. With the aid of slides, he told of his trip to Ireland and presented an interesting and informative description of the country, its people and its architecture.

Social activities, in addition to the banquet, included swimming, boating, horseback riding, tennis, golf and dancing.

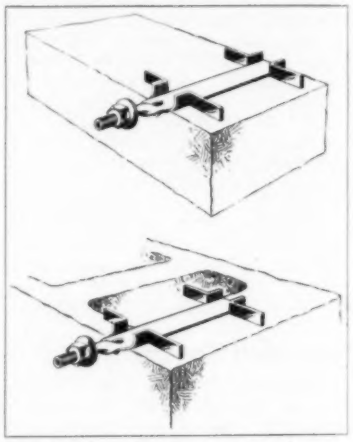
N.R.M.C.A. Insurance Plan

NATIONAL READY MIXED CONCRETE ASSOCIATION announces that its group insurance plan (see ROCK PRODUCTS, July, 1952, page 117) which has received wage and salary board approval, can now become effective as soon as members of the association have at least 600 employes participating in the plan.

The association has issued a number of publications in regard to the plan. These include: (1) a large booklet entitled, "Group Insurance Plan for You and Your Employes," which contains a summary of the plan and an explanation of its benefits; (2) a "Memorandum on Legal Aspects of N.R.M.C.A. Group Insurance Plan," prepared by the association's counsel which discusses legal questions affecting participants; (3) a small booklet entitled, "Information for Employes of Members of N.R.M.C.A.," containing more detailed information with respect to benefits available under the plan for employes and their dependents; and (4) a booklet entitled, "Trust Agreement Establishing Group Insurance Plan." The trust agreement, dated May 7, 1952, between the association and the trustees, establishes the trust through which the plan will operate, and sets forth in detail the respective rights and responsibilities of the trustees, the association and the participating members.

Masonry Bolt

THE ACCOMPANYING ILLUSTRATIONS show applications of the new "Wallbolt," recently developed and marketed by Zoller Manufacturing Corp., Tiffin, Ohio. The Wallbolt is a new



Special bolt may be set in block, brick or tile walls without bending or deforming

building product developed to eliminate the labor of bending or deforming straight machine bolts for setting in block, brick or tile walls. Its most common application is in connection with framing for garage door openings, pedestrian door jambs and window frames. Its design permits it to be set at the precise location and permits its being embedded in 12 sq. in. of mortar area.

Concrete Pipe Meeting

OREGON CONCRETE PIPE MANUFACTURERS ASSOCIATION held a general membership meeting June 16, 1952, at the University Club, Portland, Ore. Subjects discussed included the group's research program on tamped pipe at Oregon State College; a discussion of the actions of the recent meeting of A.S.T.M. Committee C-13 and the joint meeting of American Concrete Pipe Association's Technical Problems Committee and Hydrogen Sulfide Committee. John Ash was chairman of the meeting.

Irrigation Pipe

(Continued from page 257)

of Valley Brick & Tile Co., Mission, Texas. The pozzolan was said to add to the appearance of the pipe and when used as a 25 percent replacement for portland cement, strengths at 28 days are about equivalent to

Lifting the solid aluminum form from the green pipe prior to curing

those reached by pipe made of a 100 percent cement mix.

Valley Concrete Pipe Co. is under the management of A. C. Clark, who is also general manager of the company. The plant is about 1½ miles east of the city limits of McAllen.

A. C. Clark, general manager of the company

Concrete Pipe Plant

UNIVERSAL CONCRETE PIPE CO., Columbus, Ohio, has opened a plant at Jessups, Md., 12 miles southwest of Baltimore. Equipment for producing 6- to 72-in. pipe was sent from Universal's machinery division at Columbus to the new plant at Jessups. A casting yard has also been established at the Jessups plant for making larger diameter and long length pipe.

In addition to round and culvert pipe, the Jessups plant will handle flat-base pipe for pedestrian and cattle passes, special pipe for utility galleries and manholes, reinforced concrete river weights and open- and

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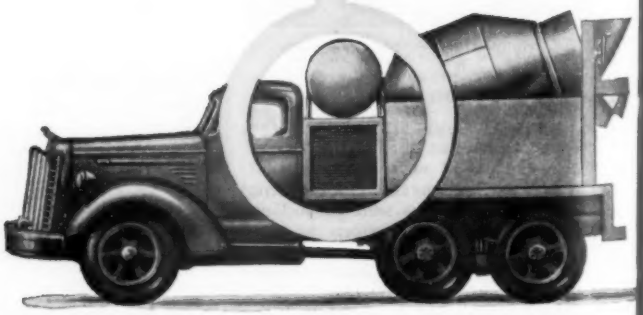

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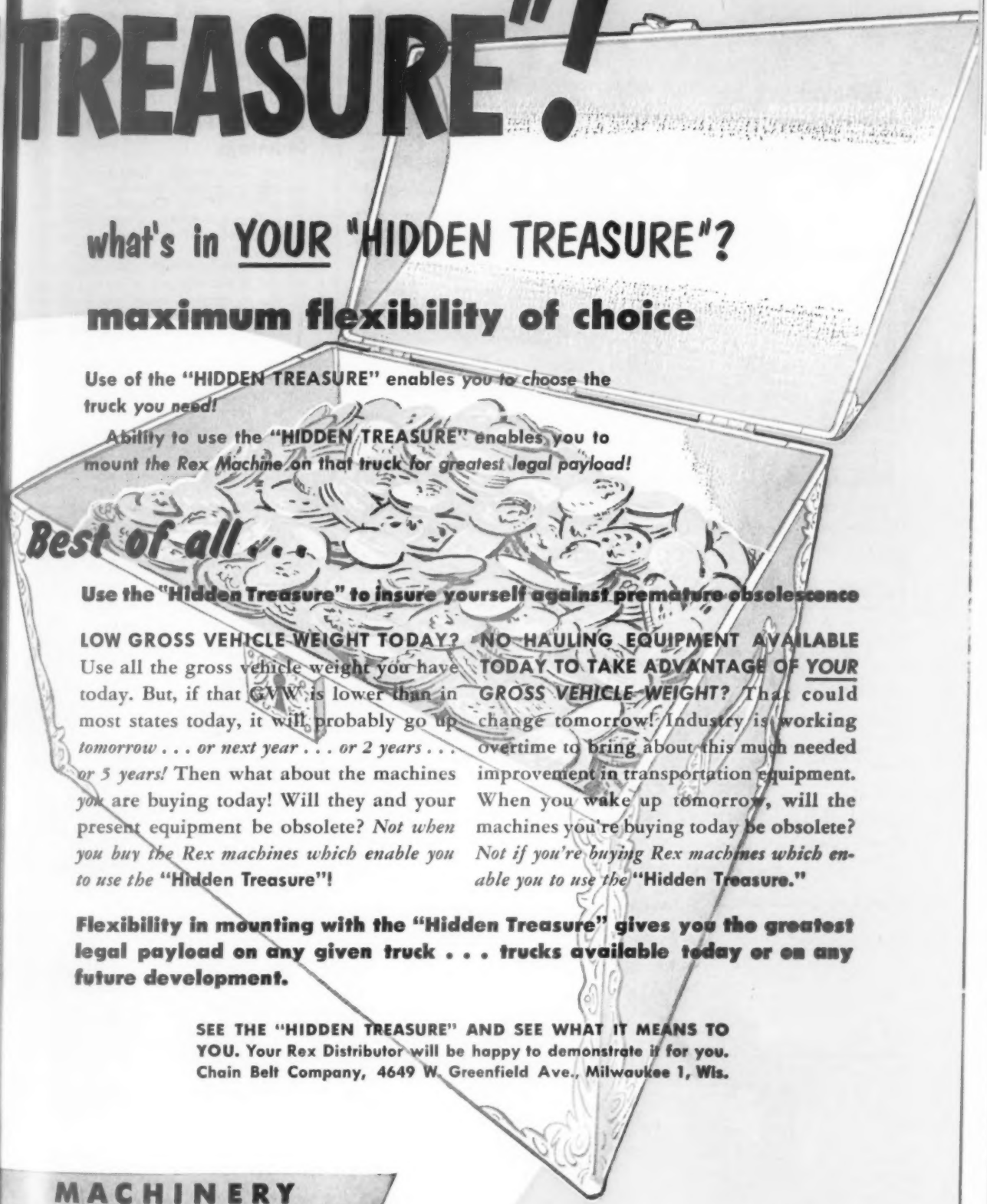

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MACHINERY

closed-face concrete cribbing.

Harold Leuliette, manager of Universal's Norristown, Penn., plant, has charge of the new Maryland operation. Frank Bartrug is production manager and Henry W. Gadde is sales representative.

Concrete Pipe Committee Meetings

THE TECHNICAL PROBLEMS COMMITTEE and the Hydrogen Sulfide Committee of the American Concrete Pipe Association, held a joint meeting, June 3, 1952, at the Sherman hotel, Chicago, Ill.

The first problem discussed concerned recent failures in various parts of the country of large size concrete pipe under rather high fills. It was recommended that the association staff initiate a program of education in the bedding and backfilling of large size concrete pipe, as well as in the importance of constructing the larger sizes in accordance with the specifications.

Another problem considered was how to protect concrete pipe from corrosion both internally and externally. This problem was approached from three angles: construction methods; addition of admixtures and use of protective coatings.

Gene Bespalow is chairman of the Technical Problems Committee and George Denham is chairman of the Hydrogen Sulfide Committee.

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SEPTEMBER 1952

Limestone carrier John G. Munson